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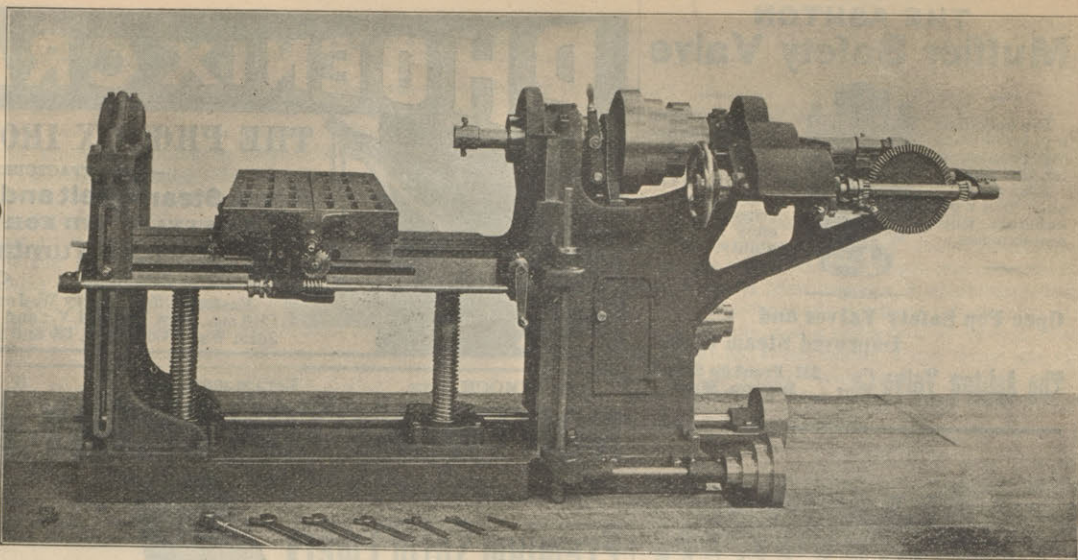
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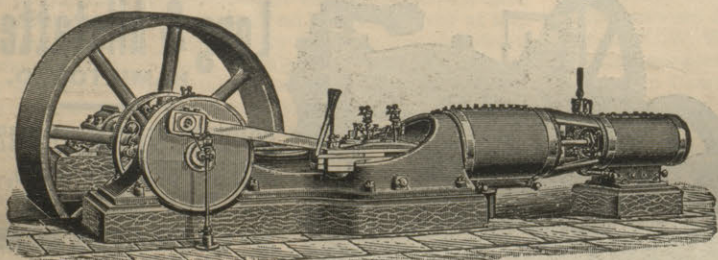
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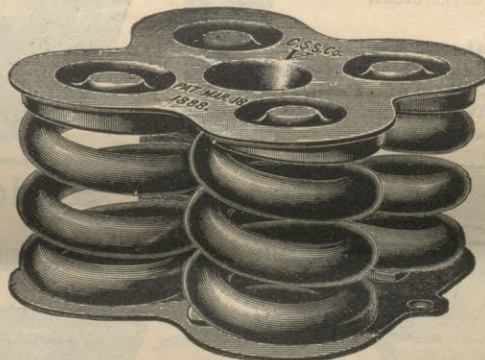
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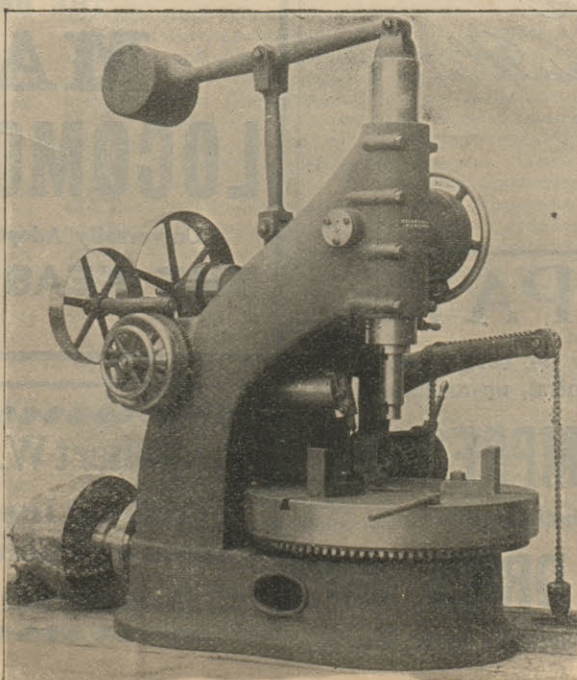
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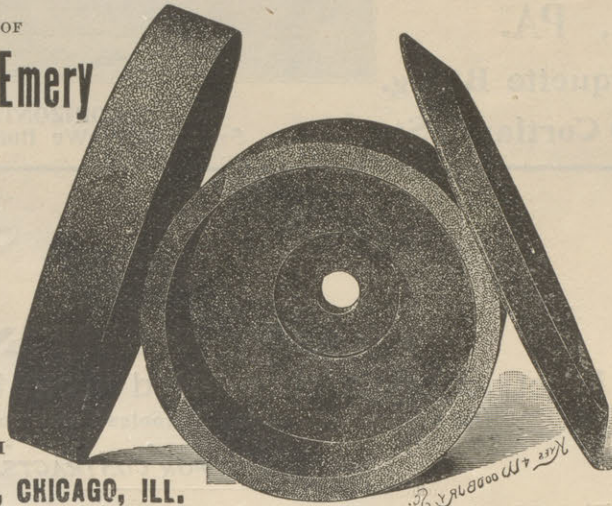
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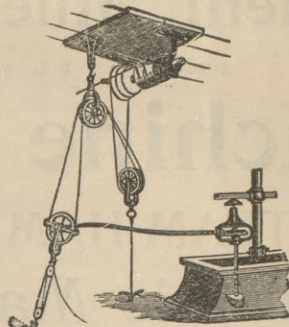
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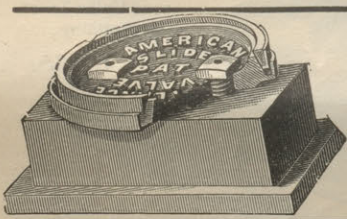
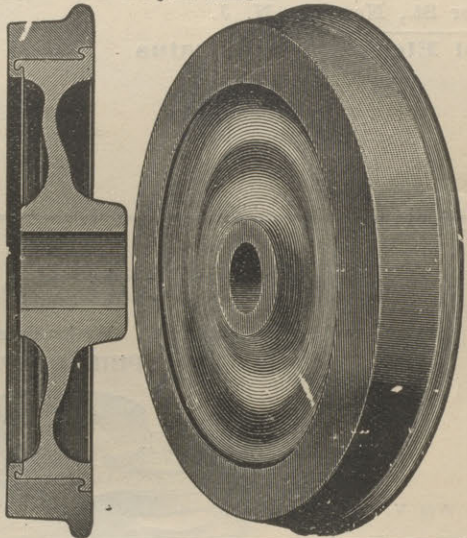
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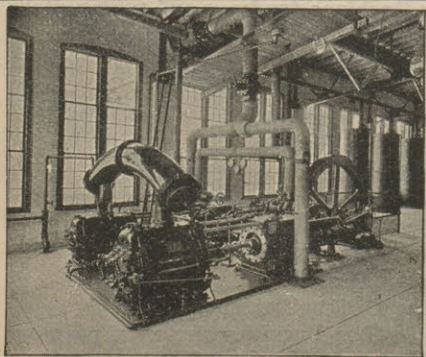
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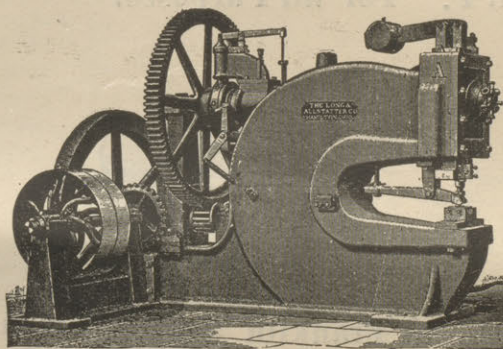
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THE RAILWAY REVIEW

No. 48

NOVEMBER 28, 1896.

XXXV.

USES OF ACETYLENE GAS.—Some small cars propelled by motors driven by acetylene gas have lately been constructed in Italy. The charge consists of acetylene gas dissolved in fifteen times its volume of air, and with this mixture it has been found necessary to use water for cooling the cylinders. The method of igniting the charge has not, however, been made known. According to the Gas-techniker, the motors maintain a speed of 600 revolutions throughout a working period of fifteen hours. The weight is only about 20 lbs.; and 0.8 brake horse power is developed. The cost of working is said to be about 12 cents per hour. Acetylene gas generators are now used to furnish light for magic lantern purposes. Calcium carbide is placed in the generator, and water admitted at the bottom through a stop-cock. As the water rises and comes in contact with the carbide, the acetylene is generated and escapes into a receiver and thence to the burners. When more gas is generated than is used the increasing pressure depresses the water level, and almost stops the generation of gas. The gas is burned in the lantern in four 1-ft. burners, each giving a perfectly white light of 125 c. p. It is claimed that the convenience of the apparatus will cause acetylene to entirely supplant the oxy-hydrogen light commonly used for magic lanterns.

SHOP DRAWINGS.—It may appear as a curious fact that many men who have had years of experience in shops, and who are good workmen, seem to be afraid of drawings. While working to them with accuracy, and finishing their jobs satisfactorily, they never seem quite at rest in regard to the meaning of their drawings, and frequently remark: "If I had another job of the same kind to do I could get through it in much less time." This means, practically, that if they had a model before them instead of a drawing they could turn out their work more easily. It raises the question, too, whether it would not pay to give more attention to making drawings plain and to teaching the men to read them. Shading of parts, and increasing the pictorial effect in general, so as to make one piece stand away from another, would seem to be a good thing, and in this respect some of the older forms of shop drawings might well be taken as examples worth following. To-day many of these out-of-date drawings are considered as having been wasteful of drawing office time, and uselessly elaborate, and yet they had good points. They told their story in a way quite foreign to the modern blue print.—[Cassier's Magazine for December.

FLY-WHEEL MATERIAL.—The great velocity at which fly-wheels are driven and the consequent casualties that have become a matter of weekly report are evidence of slow evolution in providing for known wants. The sudden advent of electrical apparatus and its high speed found people making fly-wheels of cast iron, with a narrow factor of safety, or, indeed, no factor of safety at all, if we consider the impossibility of detecting inherent strains and imperfections in this material. No one can know the value of material molded into form at a temperature of 2,000 degrees and then cooled down to a fortieth of this temperature, nor can they judge internal structure by surface indications. The fact is, says Cassier's Magazine, that cast iron is not suitable material for fly-wheels that are to be driven at high speed, nor is it necessary to make them of this material. There is not even the claim of cheapness in their favor, if the methods of making such wheels of wrought iron and steel were once worked out. Twenty years ago a Scotch firm, who had to make a large fly-wheel for a spinning mill, riveted up a box rim, made from rolled plates, and filled it with cemented masonry or "grout" and did a very sensible thing. The strength of rolled sections is tolerably well known, their integrity is beyond doubt or can be so, and all that is wanted is some ingenuity and experiment to substitute this kind of material. One reason for using cast iron for fly-wheels is to attain a section and stiffness of the arms that will, in the plane of rotation, resist the inertia and momentum of the rim. The sections of wrought iron spokes required for radial or centrifugal strain are by far too weak for the driving strains, but this is easily provided for by diagonals, as in case of other iron structures.

RAPID REPLACEMENT OF A BRIDGE.—An interesting piece of rapid structural engineering work was accomplished on the Great Eastern Railway system during the early hours of a recent Sunday. The railway bridge over the River Ouse, on the London & Norwich main line near Ely, was completely removed, and a new wrought-iron bridge of one span, of some 300 tons deadweight and 130 ft. long, erected in its place. The night was extremely dark, and the work was rendered somewhat difficult by the prevailing high wind and heavy gusts of rain. About 1.30 a. m. operations were begun by removing the rails and upper cross-timbers. Half an hour later the first of the iron girders, which numbered 20 in all, and weighed about six tons each, was lifted out by powerful steam cranes and shunted onto trucks. The work was completed by 7.30 a. m. Preparations were now made for placing the new bridge, which had been previously erected on staging

alongside the old bridge, into position. This was effected by slowly hauling the entire structure by means of powerful winches fixed on both river banks. The bridge itself rested on trolleys running on rails laid along the abutments. The next business was to relieve the trolleys of their 300 tons of dead weight, and to lower the bridge by powerful hydraulic jacks onto its permanent supports. This done, rails were laid, the permanent way was made good, and the main line connection completely restored, with a delay to only one train of the ordinary Sunday service. The operations were carried out, under the direction of Mr. John Wilson, chief engineer of the line.

RAISING A RAILWAY BRIDGE UNDER TRAFFIC.—An interesting engineering feat has been performed on the railway bridge which crosses the Old Maas, near Dordrecht on the line from Rotterdam on which traffic is lively. The system consists of two swing bridges and four girder bridges. The girder bridges have lengths of 287 ft. and 212 ft., the swing bridges of 175 ft. and 114 ft. Of the seven piers in the river, not counting the two on shore, I. and V. formed the pivots for the swing bridges; both girders were fixed on piers III. and VII., and rested free on piers II., IV. and VI. This arrangement of the year 1873 did not answer. Passing trains caused heavy concussions which various remedies would not prevent. It was finally resolved, therefore to change the whole arrangement, that is to say, to place the fixed joints on the piers II., IV. and VI., and to allow for expansion on the others. For this purpose it was necessary to place the new free ends on rollers which could not be more than 10 centimeters, 3.94 in. in diameter. This is an unusually small diameter. Calculations based both upon Morrison's and upon Weyrauch's formulae gave seven rollers for the large bridges; hence this figure was adopted, though neither of the two formulae was rigorously applicable. The lifting of the bridges was to be done by hydraulic power. The simplest plan would have been to place the four presses at the four corners of each bridge. But there was neither sufficient clearance nor sufficient base space available on the piers and it was decided to raise the four bridges which rest on piers III. and VII., simultaneously, both by providing recesses on the piers on which the hydraulic presses stood on 2.5 in. steel plates and by fixing brackets on the girders against which the rams pressed. The two smaller bridges did not cause any trouble. But with the larger bridges the hydraulic pipes began to leak when the pressure reached 350 atmospheres; yet the pressure had to be increased to 450 atmospheres (about 11,000 lbs.) The work was done during train intervals of 10 or 15 minutes, the bridges being each time lifted a few millimeters and propped up by steel and oak timber. The chief trouble arose from a side tilt of the bridges, which slipped more than three inches; when the lift had been accomplished, the shifting had to be undone, which was accomplished by means of the rams and 20 ton jacks. The rams could each lift 200 tons. There was according to "Glaser's Annalen" further trouble because the oak boards were crushed, and the iron girders slightly bent. During the most anxious time the railway traffic was sent over one or the other track.

A VERY LIBERAL BUSINESS TRANSACTION.—As many harsh things are being said about men of wealth in these days, it may not be out of place to refer to a private transaction between John D. Rockefeller and the ship building firm of F. W. Wheeler & Co., West Bay City, Mich., who has just completed three big steel vessels for the Bessemer Steamship Company, which is the corporation operating Mr. Rockefeller's ships on the lakes. It is well known that there was a clear understanding with all of the ship builders who undertook to furnish vessels for the Bessemer fleet within a specified time, that a premium would be paid for advance delivery and that demurrage would be charged for delays. Both premium and demurrage were fixed by stated figures covering each day of advance delivery or delay in delivery, and when the vessels were finished settlements were made on this basis. In the case of Wheeler & Co. the completion of the vessels was very much behind time. Without going into details, it is sufficient to say that Mr. Rockefeller's representatives had in their hands a claim for demurrage against the West Bay City firm aggregating nearly \$40,000. Part of this might have been offset by counter claims, based mainly on labor troubles at the ship yard, but it is understood that a strict adjustment of the matter, with other settlements and a legal precedent to follow, would have resulted in very little reduction for the builders. Still Mr. Wheeler and his associates had given to Mr. Rockefeller three of the best ships that had ever been built on the lakes. Nothing was spared to make them complete in every particular and to satisfy every desire of the men who were to manage and sail them. This was in reality the only counter claim presented to offset the demurrage account. There was a moral obligation involved. The matter was presented to Mr. Rockefeller's representatives in New York, and their answer was to deal with Mr. Wheeler in accordance with the spirit that characterized his work, making him feel that he was not to be the loser on account of a liberal policy in furnishing good ships. The big demurrage claim was entirely wiped out.—[Marine Review.

BRICK FROM SAND.—An organization has been incorporated in California under the name of the California Stone Brick Company, which proposes to manufacture bricks from sand, no other ingredients entering into their composition than that contained in sand or earth. Plans for the kiln have been drawn and a search is now being made for a proper site. The process to be employed is that of Prof. E. C. Brice of Washington. The stone brick which

it is proposed to make is manufactured from powdered stone or the elements contained in stone, such as sand, clay, etc. These substances are mixed with a prepared "flux," which acts as a bond, holding together the particles of sand or other material used as a filler, the whole being thoroughly annealed by heating. Among the advantages claimed for the Brice brick is the saving of time, only ten hours being needed for their manufacture instead of eight to thirty days; a much less consumption of fuel, scarcely any loss from burning, a crushing strength of from 10,000 to 45,000 pounds to the sq. inch instead of from 400 to 4,000 pounds, and a reduction of cost to three-fifths of that of the old style bricks. Prof. Brice has visited the coast several times within a few months and is expected soon to return, after which final steps will be taken for the building of the plant.

A PECULIAR BRIDGE APPROACH.—At Hastings, Minnesota is a high wagon bridge with a spiral approach at one end, said to be the only one of its kind in the world. The height of the channel span is 380 feet, and in order to avoid a steep grade, which a straight approach would render necessary, a spiral approach was designed and built upon land adjacent to the bridge. Beginning at a little distance from the bridge an approach starts with a rise of 7 3/4 feet to the hundred, forming an earth grade banked between massive retaining walls 120 feet long. The spiral, built of steel, begins at the end of this drive and winds its way with a curve of 60 feet, and a grade of five feet to the hundred for a distance of 385 feet; then striking again a straight approach from the point where the spiral ends, there is a rise of six feet to the hundred for a distance of 120 feet, to the beginning of the channel span. This span is 380 feet long from center to center of end piers. Beyond is another 120 foot span; then 21 spans of 33 feet each, terminating with an approach of 172 feet, making a total of 970 feet.

USELESS CONTROVERSIES.—It is curious to note the arguments that will sometimes be raised on a purely suppositions case that could not possibly exist, like the darkey's likening of the telegraph to a dog upon whose tail you stepped in Atlanta and which immediately howled in Macon. "But dey couldn' be no such dawg," objected his hearer. "But spose dey wuz." "But dey couldn' be," and there they stuck. So with a recent statement to the effect that if the steam chest pressure, the point of cut-off and the speed of the engine should remain constant the horse power developed would be the same regardless of the actual load. This might vary from zero to a thousand and yet that marvelous indicated horse power would remain unchanged. "But dey couldn' be" such an engine. Imagine the results in an engine room of a hundred horse power engine where there would be a simultaneous breakage of the main belt and the governor connections which would accomplish the instantaneous drop in the load from a hundred to zero. The next block would be a good place in which to be located about that time, for thirty seconds would probably be an ample allowance to accomplish the wrecking of the whole establishment. So it seems that our contemporary who is devoting space to the arguments in the case is simply taking up a matter that "couldn' be."—[Dixie.

NEATNESS PAYS.—Sometimes it is a great temptation to mention names, but it will hardly do, and here is a case in point. I was wandering about the yards of a railroad shops about three weeks ago where, despite the fact that it was the "bone yard," there was not a vestige of refuse of any kind. The planking between the tracks was actually swept clean, and though there were fifty or sixty men at work there was nothing lying about to stumble over. I asked my companion how much less it cost him to keep things clean than in confusion, to which he replied that it certainly cost him no more, but as he had never tried the confusion plan he could not give the actual saving. I went from there direct to a big car manufactory, and it was big; big in the acreage of ground it covered and bigger still in the confusion that existed. I thought I had seen bad places before but I never had. Nothing in my wildest imagination had ever equaled it. Car timbers of all sorts and dimensions were tumbled confusedly together. In one heap I saw different lengths of longitudinal sills, corner posts, cross-tie timbers and end sills. Shavings and chips had accumulated like the leaves of a primeval forest, and I actually do not know whether there was any floor in the planing mill or not, other than mother earth. We were after the dimensions of certain cars that had been built. Of course drawings were an unheard of quantity, so we started to search for the laying-out pole. At first we were the assistant superintendent and myself, increased in ten minutes by the man who had charge of the poles, again increased at the end of another ten minutes by the department foreman, only to be eked out shortly afterwards by two laborers, to say nothing of the man whose machine we were obliged to stop while prosecuting our search. Of course it was dusty, and the more the poles were handled the dirtier we and the air became, until every one was irritated and ready to swear, and I am not sure but that some of us did. Well, after an hour and a half of pulling and hauling we gave it up because some of us guessed it must have been put elsewhere. I do not know what the search really cost the company, but I do know that if I had a job it would not go there. I am inclined to think that such a place would add to its income by opening its grounds to the public (for a fee) just to show how bad things can be and still have the semblance of holding together. In the neat place I saw a refinement that is a little unusual. The cleaner-up of the yard had a wheelbarrow with a rubber-tired wheel. He says it runs more easily than his old barrow and that it does not jar so much on

the hands when he goes over rails. His tire is made of a couple of old pieces of air brake hose split lengthwise, sprung over the wheel and tacked down on the sides.—[J. H. Allen in Dixie.]

A PRACTICAL VIEW OF TECHNICAL EDUCATION.

An address was delivered at Lehigh University on "Founders Day," October 8, 1896, by Mr. John H. Converse, of Philadelphia, which contains a practical view of the necessities in technical education. Special notice should be given to the idea of education in the broad sense which will produce not a specialist exclusively, but a citizen as well as an engineer and more than all, a "self-reliant man." Subjoined are some extracts taken from the address.

"The ideal university might have, first, say, a three years' course in the humanities, leading as now to the degree of A. B.; and, secondly, a two years' course in technical, scientific, legal or other specific studies leading to the degree of C. E., M. E., E. of M., or other appropriate degree. And these two courses should be made, not optional, but obligatory, forming in effect a five year's course. If it be said that students will select in preference a merely technical school where in a shorter time the desired diploma may be obtained, I answer that I have no concern with that policy. My contention is that there is room for a university wherein the training afforded and enforced shall make the citizen as well as the engineer, the broadly cultured, self-reliant man, and not a specialist exclusively.

"Another advantage of the scheme, incidental but most desirable, in my judgement, would be the opportunity for practical work which might be interjected between the general and the technical courses. At the end of the three years' general course let the student spend a year in actual business or work. Employment in the line of his future profession would be preferable, but failing that, any business experience would be beneficial. To illustrate this, take the case of an intending mechanical engineer. At the end of the three years' course the university might give and encourage a year's leave of absence, during which period the young man might find employment in a machine shop or factory and obtain some practical training in the use of tools and machinery. Much could be accomplished even in that brief time, and I venture to assert that there are many manufacturers in the United States who would heartily co-operate in such a scheme. The young men, after a year or fifteen months of practical work, would enter upon the scientific studies in mechanical engineering with a higher appreciation of their value, with a more intelligent comprehension of their application, and with greater ability to assimilate the theoretical principles of the text-books. It is a well-known fact that the best draftsmen (and I use the term not for mere copyists, but for designers) are those who have had shop practice. They have learned what tools can do, and by what process results can be reached most economically and effectively. I need not extend the illustration. You will at once apply it to the case of the civil engineer, the engineer of mines, the chemist, and the architect.

"The young man who has thus taken the complete course of five or six years will, when he finally receives his engineering degree, be entitled to stand as a thoroughly educated engineer. His culture will have been broad and liberal. He will be equipped for the highest citizenship, and can stand as a peer of any in the community. There are few professions where the widest knowledge can more fully be utilized than in that of the engineer. No man, whatever his calling, can know too much. He will find use in the most unexpected manner for attainments apparently foreign to his pursuits.

"The engineer, of all men, must be a practical man, a man of business. He must be able to write concisely and vigorously. If he possesses the faculty of a public speaker, it will come in play. His knowledge of business forms and methods should be complete and exact. He should be a bookkeeper, a banker, a manufacturer, a merchant. Something at least in all these pursuits may fall to his lot in the varied conditions of his professional life. All these attainments, and more can be utilized if he is to fulfil the definition of an engineer which have already quoted, as one capable of 'directing the great sources of power in nature for the use and convenience of man.'

"Complete as will be the education of the engineer as the result of the system which I have outlined, it will not be all that will be required in actual business.

"The education will, it is true, be an effective implement, but its owner will still have to learn its use. The interests of manufacturing and commerce have little respect for the dignity of science. Their motto

is 'nothing succeeds but success'. The practical man, who knows thoroughly a few things, is considered superior to the theorist, who has a partial knowledge of a variety of subjects. The graduate must, therefore, be ready to subordinate his training to the necessities of business. He will, undoubtedly, in good time, find ample opportunity to use all his acquirements; but he must be content in entering on his work to accept conditions as he finds them and to wait patiently for an opportunity to utilize his knowledge. There is one term too commonly used which is mischievous in its influence. We hear of a young man seeking a position in a business. It is not 'position', but opportunity of usefulness that should be sought. Faithful and intelligent service will generally secure recognition in the long run. A young man of my acquaintance, who had completed his course as an electrical engineer, sought employment with the Westinghouse Electrical Company. The first work to which he was assigned consisted in trueing up by hand the plates of an armature and covering it with asbestos, a process which, perhaps, could have been as well done by an ordinary laborer. The manager grimly remarked that such a job was what they usually assigned to college graduates. The young man accepted the task without a murmur, and in no long time was promoted to more important and congenial duties. Another case within my knowledge is that of a young man who had received his degree as a mining engineer. He learned that a certain smelting works in one of the western states had applied to the president of his institution for someone to serve as helper in the assay department. The salary was inconsiderable but the place was accepted and within one year he had been promoted by successive steps until he was offered an engagement as manager of the works.

"One more instance will suffice. At the commencement exercises of 1895 of my own Alma Mater, a young man, just graduated as a mechanical engineer, applied to me for employment. It was arranged, and on September 1, he reported for duty and was assigned to work in running a shaping machine in a night gang. Several promotions were secured in a reasonable time, and in May last, an application which was received from the government of the United States of Colombia for a principal instructor in a mechanical school in that country, was filled by the nomination by his employers of the young man referred to. I have every reason to believe that he is satisfactorily and successfully discharging the duties assigned him.

"As a general proposition, then, it may be said that the demand in business is for men who can accomplish specific results. Any opportunity of service, if in the right direction and patiently and faithfully utilized, has in it the promise of a successful and useful career. Add the broad, complete and symmetrical training which it is the function of the university to give, and the result may be not only individual prosperity but true citizenship."

TRUCKS FOR MOTOR CARS.

A paper upon street railroad trucks was presented by Mr. John N. Akarman, superintendent of the Worcester Street Railway, at the recent convention of the American Street Railway Association in St. Louis, the chief points of which are given in the following abstract:

When motors were first placed upon street cars, it was believed that there was no necessity for special construction, or any marked departure from the prevailing horse car practice. The idea of a separate truck had not even been conceived. We found Vandepole placing his motors upon the front platform, and using chains and sprocket wheels to carry the power to the axle. The car carried the whole weight of the motor and load, and in addition to its usual work, took all the strains of the propelling power. Sprague made a short step in advance and in the right direction by carrying his motor on links from the car body and resting one end through sleeves on the axle. This improvement preserved the distance always the same between the motor and the axle, but the rising and falling of the body imparted a racking motion to the motors, which was destructive to the cars. Both of these systems were radically wrong. The idea of a separate truck was first conceived about the year 1885, but it was not until the latter part of 1887 that, in its concrete form, it was put into operation. The first truck consisted of a continuous upper chord made of bar iron in the form of a rectangle. Its purpose was to support the car body, the sills of which rested on its frame. The sides of this upper chord were reinforced by heavy oak sub-sills to which the chord and the pedestals were both firmly bolted. This form of frame kept the body square and took many of the strains on itself, but it has been abandoned, and in abandoning it and using separate bars, we have been drifting away from the best practice, for it had a very important advantage in preserving the squareness of the body and truck. In addition to this upper chord, there was a bar extending around the truck to which the bottoms of the boxes were fastened.

In all the early trucks, the frame rested directly on the journal boxes. The jar and concussion injured the motors, and made it impossible to keep bolts and nuts tight, and was the cause of a rapid destruction of the whole truck. A remedy became imperative, and cushioning was resorted to. The first effort in this direction was made by placing a thick piece of rubber upon the top of the journal box between it and the axle box frame. While the principle was right the means employed was of little value. Then a spiral spring was tried upon the top of the box. This was an improvement, as it had a certain amount of motion; but the space available over the box was so small that a very stiff spring was required which was but little better than rubber. It was found that springs in this position had the disadvantage of aggravating the rocking of the box from side to side; but by widening the box at the bottom, or adding ears so as to form spring seats, it was found possible to give each box two springs, one on each side, and of ample diameter and length to carry the load with ease and to provide sufficient motion. Thus placed, they had the advantage of carrying the box perfectly steady, preventing entirely the rocking and unsteady motion. These motors were carried on the truck and were in no way attached to the car body or connected with its motions.

The brakes were first suspended from the sills of the car, and the sinking of a body under a load left the shoe so far from the wheels that in applying the brakes the slack of the chains was increased and could not be taken up without considerable delay. The remedy was simple and consisted in suspending the brake rigging from the axle box frame in such a way that it was not subject to the action of the body springs.

The change in the brake rigging from the car body to the truck frame brought another evil which had been of slight importance heretofore. This was the longitudinal rocking or pitching of the car body, technically known as galloping, which was greatly increased under high speed, and is also further increased by lengthening the car bodies. This motion is not only excessively unpleasant to passengers, but very destructive to the trucks, motors and track. When the brakes were hung from the car body it was possible to check this oscillation by a slight application of the brake, but the change in the hanging of the brake made this impossible. The first thing that was done as a remedy was to increase the wheel base, but this did not prove to be of much advantage. The first success as a remedy appears to have been made by extending the sides of the truck, and on the extension pieces mounting an elliptic or half elliptic spring. The latter method with the half elliptic spring has been the most successful preventive tried. As experience was gained it became more evident that a motor truck was a locomotive in every sense of the word, and for success must be governed in its construction by the general principles involved in the construction of a locomotive. The greatest difference between the functions of a motor truck and a locomotive seems to be the fact that the motor truck carries the load instead of drawing it. It is moved forward by the revolutions of its axles, and is subject to combined vertical, horizontal and twisting strains of the most severe kind, and at the same time it must ride as easily as a carriage.

It has been demonstrated that a composite truck frame is a failure, because of its inability to stand all the strains imposed upon it. The braces, which were amply sufficient to carry the weight, give it no strength to resist twisting strains. As a result of the best information and from large experience, I believe the ideal four wheeled truck for electric cars is one having the fewest number of parts in its construction, in which the side pieces of the main frame are single forged bars connected across the ends by bars either bolted or welded on so as to make the frame one continuous piece. This frame is carried by springs, from the journal boxes, and itself carries an upper chord, likewise a continuous rectangular piece which has suitable seats for the springs. This upper chord is recessed to take the bolts and spring seats, leaving the upper surface flush. The ends are carried by the half elliptic springs, while the spirals are placed at the journal boxes. The brake should be hung by links. On account of the location of the motors diagonal bracing is out of the question in the construction of a truck, but the diagonal strength is usually increased by the introduction of transoms. Taken at its best, the four wheeled truck is an uncomfortable carriage and a veritable track destroyer, and should only be used, according to the best judgment of many of our wide awake railroad men, where cars are run at comparatively low speed, and with moderate length of car bodies. Where it is desirable to run at higher speed in suburban service, the damage to the track becomes so great that it should preclude its use. The increased length of wheel base made necessary makes it hard on curves.

The only alternative is to use a double truck car with swivel trucks. The advantage of this form of truck is very great. The conditions, however, are not altogether in favor of the pivotal truck. As, for instance, if all the weight is used for adhesion it is twice as expensive in use as a four wheeled truck. If two motors are used, it has only 50 per cent of the propelling power. In its ordinary form it makes a wide body necessary, and hence is out of place in narrow streets or places where traffic is very heavy. It also has the disadvantage of putting the body at a greater height than is necessary with four wheels. However, it meets a great many of the requirements for fast suburban service, but the objections which I have just mentioned preclude its use in many cases where it would otherwise be desirable. Now, the remedy for nearly all of these objections has been found in what is known as the maximum traction truck.

The maximum traction truck may be defined as a pivotal truck in which the load is eccentrically placed in relation

to the four wheels; two of them receive only a sufficient amount of weight to keep them upon the track, while the others take the remainder of the load. In practice it is found that 80 per cent of the weight may be placed on the driving wheels, while 20 per cent is used for guiding. Upon applying these trucks it was found that it was not necessary to have the wheels of equal size; that a large pair of driving wheels and a small pair of idle wheels can be used. The large pair used as driving wheels being very near the pivotal point have a comparatively small amount of swing, and can be allowed to rise within the floor timbers, while the small wheels moving through a much greater arc easily clear the sills. By this form of construction, the body cannot only be brought down, but the frame can be made as narrow as in the ordinary street car body. This form of truck enables the car to be utilized for both street and suburban service. It is also found in its latest form utilized under long open cars. It carries the motors in a satisfactory manner, guides readily and answers nearly all the requirements of the service.

As inter-urban service is almost equivalent to that of the steam roads, for this service, pivotal trucks having regular swing beams, equalizers, elliptic springs, and all parts of the steam road truck are entirely satisfactory. They take curves easily at a high rate of speed. But for trucks which must run not only on trams, but on T rails, some form of the maximum traction truck will give, all things considered, the best service.

In conclusion, let me call attention again to this very important question to be considered in connection with the adoption of single and double trucks, which is, whether the punishment to the track by single trucks is not so great as to more than make up for the cost of putting in and running double trucks under cars of all lengths of bodies, whether short or long.

SHOP TRAINING OF APPRENTICES.

An outline of the experience which apprentices have undergone in railroad shops was given by Mr. Wm. Forsyth, mechanical engineer of the Chicago, Burlington & Quincy Railroad, before the Western Railway Club at the last meeting, in the following words, this being a portion of the discussion on the paper by Mr. J. N. Barr, which was reproduced in the RAILWAY REVIEW of November 7, 1896:

I am glad to have an opportunity to-day to say a word in the interest of the apprentice boy, because I was one myself, and worked through the weary hours of a regular apprenticeship. The system which Mr. Barr describes in the first part of his paper as advancing the boy's pay each year through the four years, and that being about the only interest which the railroad or the foreman takes in him, was in vogue at the time I learned my trade more than twenty-five years ago, and seems to be the same to-day. I feel that the committee of the Master Mechanics' Association and Mr. Barr himself, with all his natural conservatism and practical good sense, have overlooked the main point in this question. They have gone beyond the practical training of the apprentice, and they have undertaken to set up a technical school in our railroad shops. I do not believe that this is the first thing to do. I do not believe it is the most important thing to do, for I think that nearly every railroad shop has in its superintendent of motive power and in its foreman the opportunity to do a good work for the apprentice boy, but they are shirking it, they are avoiding it, apparently as Mr. Barr has done in his paper. When I was learning my trade I was given an old lathe, with a worn out lead screw, and a rickety tail-stock, and a slippery belt, and I was kept there turning bolts for several months. The foreman did not take any interest in me, there was nobody in the shop who tried to teach me anything, and if I learned anything it was because a boy absorbs something from his surroundings in four years, and he may be able to pick up something for himself if nobody helps him.

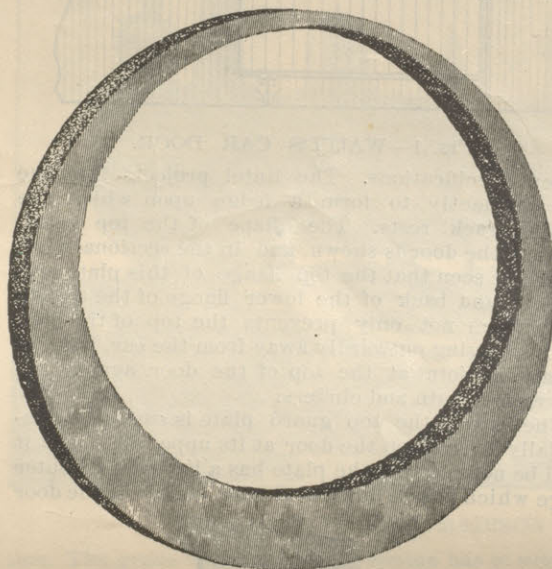
That really is the condition of the apprentice boy of most railroad shops in this country to-day. So that if we want to do anything to help him, do not start with an ambitious scheme of giving him a technical education, but let us look after him a little in the shop, and in the first place try and make a good mechanic of him. As a practical suggestion in this line I should think we ought to try and find some one in our shops who is a natural teacher, if we can, some good mechanic who has a faculty of imparting knowledge to others, and let him have some oversight of the apprentices. Let him be one that they can go to and ask questions, find out something about what they are working at, and after that establish a class of some kind and get started at a night school and gradually develop an attempt at some of the education which Mr. Barr has outlined in a very good way in his paper. I should think, too, that there ought to be two kinds of apprentices, one whose aim is to be a good mechanic, and another who is ambitious to be something of an engineer. The course of the two should be slightly different. The mechanic would probably spend most of his time in the machine shop and be given a general course through the erecting shop, and with all the various machine tools. The engineering apprentice ought to have in addition to that some time in the pattern shop, and then in the foundry if possible, and in the testing room and in the drafting room.

As for the regular machinist apprentice there is a greater necessity now for some reform in this direction than there has been in the past, on account of the piece work system which Mr. Rhodes has mentioned. I believe that the tendency is to specialize work, and nothing is going to do it more rapidly than piece work, and if you are not careful we will have our apprentices making one thing for months at a time, and they will not become skilled

mechanics. So I hope that in the ambitious schemes for education which have been mentioned in connection with the apprentice boy since the Master Mechanics' convention and at that convention, we will not lose sight of his mechanical training in the effort to make him a skilled mechanic.

Cast-Iron Steam Pipe.

It has been said that "things that are not constant are mighty uncertain" and the truth of this aphorism is nowhere better illustrated than in the use of cast-iron steam pipe. We have in mind a large manufacturing establishment not a thousand miles from Connecticut, where a line of 8 in. cast-iron pipe had been in use as a steam main for fourteen years, carrying a pressure of 75 pounds. That part of the pipe which was in the boiler room had failed on several occasions, but each time there was some very fortunate circumstance about the accident, so that no great damage was done. It was feared, however, that this continued run of good fortune might not always prevail; and as a matter of precaution it was decided to take out the cast-iron and put in something better. The pipe in the boiler room was removed and broken up for old iron, and was replaced by a modern wrought-iron pipe with riveted flanges. The cast-iron that had been in the boiler room was entirely discarded, as we have said; but those lengths that were in the engine room were supposed to be of superior quality, inasmuch as they were extra heavy, and were made "on honor," and so it was thought best to preserve this part of the piping for possible future use. Not long after the pipe had been changed, the company wanted a cast-iron column for some purpose or other, and bethinking themselves of the high grade piping that they had reluctantly taken out of the engine room, they put a section of it in a lathe to cut it off to the right length; and when they made the cut, they made a discovery also. The nature of the discovery is shown in the engraving.



which is made to scale from a ring of the pipe that was sent to us for the purpose. On one side the pipe was $1\frac{1}{4}$ inches thick and on the other its thickness was a scant quarter of an inch. It is hardly necessary to say that the firm that had used this pipe as a steam main for fourteen years, has had enough experience with cast-iron steam pipe, even when it is "made on honor."

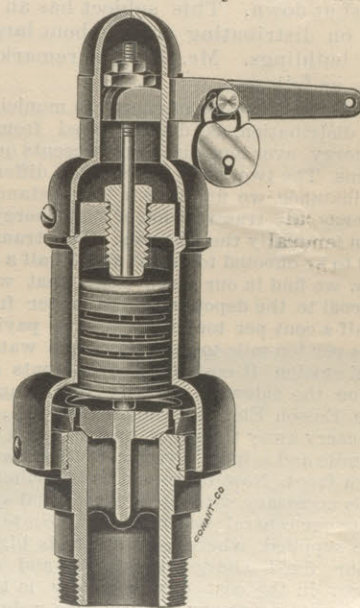
We do not question the good faith of the makers of cast-iron pipe that we have described. It is probable that they believed it to be sound and perfect; and we must therefore look to the process by which such pipe is made, if we wish to find the most likely explanation of the defect. In casting large pipe a hollow iron core is used, which is perforated with numerous holes, and also studded, on the outside, with little points or projections. The core is coated to the proper thickness with a composition of flour, coarse sand and molasses, which is held in position by the projections or studs, and the whole is placed in an oven and baked. (Bolland recommends the following mixture for covering the core: 8 quarts fire sand, 2 parts Jersey molding-sand, 1 part flour; mix with thick clay water.) When the covering is hard and dry, the core is placed in the mold, and the casting is made. Now the core, being hollow, and being immersed in the melted iron, will be buoyed up powerfully, and means must be provided to hold it in position, yet even if the ends of the core are held firmly in position, there is danger of the middle springing upward by a sensible amount, unless it is quite stiff and rigid. A small amount of yielding will be sufficient to destroy the uniformity of thickness that is essential to good pipe. In the case described above, the core must have been about ten feet long, and a "spring" of half an inch at the middle (which is not

at all impossible) would have been quite sufficient to account for the observed inequality in thickness.

The general conclusion to be drawn from this example, we suppose, is, that cast iron should not be used for steam pipe. This is a corollary to the more general proposition that cast iron should not be used in any place where it will be exposed to a tensile stress. It is good enough material for resisting compressive strains, but it is altogether too uncertain in its behavior to be trusted under tension.—[The Locomotive.]

A NEW LOW PRESSURE POP VALVE.

The Ashton Valve Co., of 271 Franklin St., Boston, Mass., has recently placed upon the market a pop valve for use upon low pressure steam boilers, such as are employed in residences and other buildings where steam heating apparatus is used. This valve is made with the under discharge outlet which was designed to prevent dust or dirt from reaching the interior. All the working parts are made of a special composition metal peculiar to the product of this concern and the spring is of Jessop steel, the combination being arranged with special reference to durability and reliability. The



A LOW PRESSURE, POP VALVE.

lock up attachment prevents the valve from being tampered with and the trip lever makes it possible to try the valve whenever desired. It is made in five sizes from $\frac{1}{4}$ in. up to 2 in. This design was made with special reference to meeting the requirements of the chief of the district police of Massachusetts and it has been approved by that officer. The use of this valve obviates the necessity of licensing the boiler attendants as engineers where pressures below 15 lbs. per square inch are employed. The revised engineers license law contains the following provision:

"It shall be unlawful for any person to have charge of or to operate a steam boiler or engine in this Commonwealth (except locomotive boilers and engines, boilers used in private residences, boilers used under the jurisdiction of the United States, boilers used for agricultural purposes exclusively, boilers less than eight-horse power, and boilers used for heating purposes only, provided with a device approved by the chief of the district police limiting the pressure carried to 15 lbs. to the square inch) unless he holds a license as hereafter provided, and it shall be unlawful for any owner or user of any steam boiler or engine (other than those above excepted) to operate or cause to be operated a steam boiler or engine for a period of more than one week without a duly licensed engineer or fireman in charge: provided, however, that every person who has been employed continuously as a steam engineer in this Commonwealth, for the period of five years next prior to the passage of this act, and who files with his application a certificate of such fact under oath, accompanied by a statement from his employer or employers, verifying the same fact, shall be entitled to a license without further examination."

The Lehigh Valley Railroad Company, on November 15, opened its new line between Buffalo and Niagara Falls, and all through passenger trains were run via Buffalo instead of, as heretofore, the trains being divided at Batavia. In addition to this through service, this company, with the new line, is in the field for local business between Buffalo and Suspension Bridge and intermediate points. Tickets have been placed on sale in Buffalo reading to all points

in Canada and the west via Niagara Falls. The high standard of service and equipment which has characterized this line in the past will be maintained and improved wherever possible, and you must not lose sight of the fact that this road has been appropriately named "America's Cleanest Railroad," as anthracite coal is used exclusively in the locomotives, thus doing away with the annoyance of smoke, soot and cinders, which are experienced on railroads using soft coal.

TRANSMISSION OF POWER BY GAS.

An interesting statement was made by Mr. Nelson W. Perry in the discussion of the recent presidential address of Dr. Louis Duncan before the American Institute of Electrical Engineers, which presents a very favorable view of distribution of power in the form of gas for use in gas engines. This is not strictly a transmission or distribution of power, but rather a distribution of fuel, though the result of the transmission is the same as if the power itself was distributed. The method has much to recommend it over electrical transmission and subdivision owing to the facility with which gas may be stored, and also to the fact that all waste ceases when the engines are shut down. This subject has an important bearing on distributing power about large shop grounds and buildings. Mr. Perry's remarks were substantially as follows:

The question of distribution of energy in municipalities, that is short distribution, as distinguished from transmission of energy over long distances presents quite different problems. The two cases are entirely different and distinct. For instance, we find that in long distance transmission of energy, the transmission of that energy in the potential form is usually the cheaper. The transmission of coal is said to be effected to-day at about half a cent per ton-mile. Now we find in our large cities that while we have got our coal to the depot or to the water front at a cost of say half a cent per ton-mile, we are paying fifty cents perhaps per ton-mile to get it from the water front to our central station. It costs fifty-seven cents a ton to deliver coal on the sidewalk outside the Duane street station of the Edison Electric Illuminating Co., of New York, and to carry away the ashes, and that is a distance of perhaps a mile and a half, not more than two miles, from the water front. Now in respect to distribution in a large city, it is necessary with our low potential system of course to locate our central station in the center of the district to be supplied where real estate is high. That means that our fixed charges are large, and one the largest charges in the cost of our energy is the fixed charges. It becomes necessary then that we reduce those fixed charges to the lowest possible amount.

With our present methods I believe it is fair to assume that the boiler room occupies about the same space as the dynamo and engine room do; that is, they are about half and half. The gas engine is a recourse which I have advocated. It would do away with the boiler room, which takes 50 per cent of the floor space. It would require a little more attendance perhaps than the steam engine, but the stand-by losses would be reduced, and it would permit the location of our plants on property which was cheap and where fuel could be had with the minimum of handling. I recently had occasion to make a few calculations as to the cost of distribution of energy in the potential form of gas. Assuming a gas of .55 specific gravity and with a calorific power such that 25 cu. ft. consumed in a gas engine per hour would give a horse power hour under fair conditions, I got some results which astonished me, and which will doubtless astonish others who have not looked into the matter.

Assuming a transmission to a distance of 5,000 yards, gas of a specific gravity of .55, and a pipe 12 in. in diameter, and to provide for bends, there was a 90 deg. bend every 200 yards, I have figured out the percentage of power consumed in the transmission under various degrees of water pressure. Under one inch of water pressure we would transmit 500 horse power of such a gas, the percentage of the power transmitted consumed in transmission would be .007 of 1 per cent. Then going to 10 in. of pressure we would deliver 1,600 horse power with a loss in energy of transmission of .07 of one per cent of the power delivered. The percentage loss in transmission with gas is very nearly directly proportional to the pressure, whereas with electricity it is the other way, and the two curves would cross each other somewhere—just where would depend upon the conditions.

While the gas transmission for municipal distribution would seem to be by far the more economical method, it would not apply at all to the longer transmissions because of the direction of these two curves which would be straight lines approaching each other at a somewhat obtuse angle. The plan which I had in mind was the location of a large plant commercial purposes on land which was cheap, on the for water front or on a railroad where the coal could be handled at a minimum of expense, and the ashes be gotten rid of with very little trouble, and the transmission of that fuel gas to centers of distribution where gas engines would be employed to drive dynamos. Those centers would preferably be centers of smaller radii than usually supplied by central stations, or if for any reason it seemed desirable to increase the radius of these districts and even with the shorter ones it might be advisable to use the storage battery in order to use the machinery and plant, and labor that we did employ to the best advantage by

operating them continuously at their best output. But it seemed to me that these figures of the cost of transmission, the drop in transmission by gas, is something that is astonishing. I had no idea that I would arrive at any such figures as those when I started to bring out these figures. In electrical transmission when the distance is not very long we allow 10 per cent. Five per cent would not be very economical in many cases, and here we go down in one case to the seven thousandth part of one per cent.

WAITT'S CAR DOOR.

The object in the design of the car door which is illustrated by the accompanying engravings, was to produce a simple and efficient guard for the top joint of the door whereby rain, snow and cinders, may be kept out, and also to prevent the door from swinging outwardly at the bottom. It was desired to provide against displacement of the door in case one or more of the hangers should become detached or broken. The design shown has been patented by Mr. A. M. Waitt, general master car builder of the Lake Shore & Michigan Southern Railway.

The arrangement includes a flanged trolley track of Z section and a top guard plate upon the door which is of T section, which are shown in the accompanying illustrations, which are reproduced from the

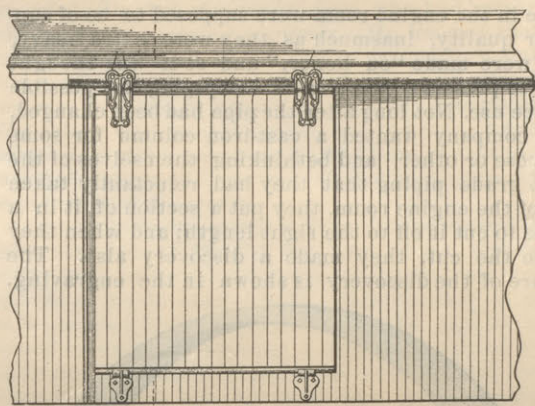


FIG. 1—WAITT'S CAR DOOR.

patent specifications. The lintel projects from the car sufficiently to form a ledge upon which the trolley track rests. The shape of the top guard plate of the door is shown, and in the sectional view it will be seen that the top flange of this plate projects up and back of the lower flange of the trolley rail, which not only prevents the top of the door from swinging outwardly away from the car, but also breaks the joint at the top of the door, against the entrance of rain and cinders.

The form of the top guard plate is such as to materially strengthen the door at its upper edge, and it will be noticed that the plate has a lip upon its outer edge which passes down over the corner of the door

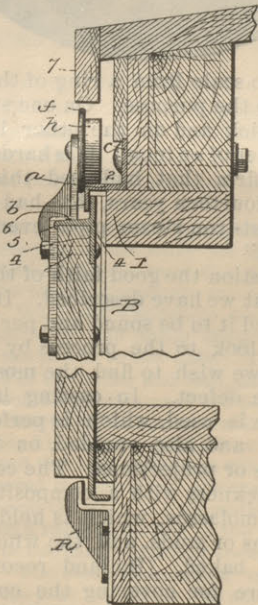


FIG. 2—WAITT'S CAR DOOR.

to further this object. The trolley rollers are provided with flanges, and it is obvious that the arrangement may be so constructed as to hold the door at the top with only the proper amount of lateral play, the flanges of the rollers holding the door from moving toward the car and the top guard plate preventing it from moving away from the car. An eaves strip is provided over the trolley rollers and track. At the bottom of the door the usual form of guide brackets is used and the door itself is provided with an angle, secured to its inner face which prevents the bottom of the door from moving away

from the car. It is evident that in this design the door cannot drop off on account of the loss of one or both of the hangers, and that unless serious damage occurs to the bottom attachments, the bottom of the door cannot swing away from the car to cause the serious accidents which are sometimes reported from doors which are not thus carefully protected.

THE COMMERCIAL POSSIBILITIES OF JAPAN

In connection with the current visit of Japanese officials to this country for the purpose of examining into the methods of steel making, and to which editorial reference is made in this issue, he subjoined communication published in the Iron Age is of more than passing interest, as indicating some of the commercial possibilities attaching to that country and its larger neighbor, China.

As to the market in Japan, the Mikado's subjects started on their career as manufacturers when the first cotton mill was opened in Osaka in 1883. At the close of 1894 there were 59 mills with 523,696 spindles. In the report of the Cotton Spinners' Union for May of this year it is stated that there were in operation 67 mills with 607,505 straight spindles, 86,404 slanting spindles, and that 453,136 spindles were soon to be added. Since the beginning of this year six new companies have been formed, proposing to work 101,083 spindles. The horse power of the machinery in actual use amounts to 15,595, while the average consumption of coal per horse power is 3,498 pounds per hour. But the Japanese have introduced many new factories in which machinery is used. They made, however, a sad failure with the foundry that was to furnish the pipe for the water works of the city of Tokyo. The municipal government was compelled to rescind the contract and call for bids from foreign houses. It was awarded to C. & J. Favre Brandt, who purchased the pipe in Europe.

Japan has now two well equipped dockyards. The oldest of these, located at Yo-Kosuka, about seven miles from Yokohama, was built for them under the supervision of French naval officers in the early seventies. Here they have launched successfully two 3,000-ton cruisers, built wholly by them and without help or advice from any foreigner. Mr. Inagaki, the banker and head of the wealthy Mitsui family, constructed and equipped another dock not far from Hiroshima, the headquarters of the army during the late war with China. When this dock was completed he presented it to the government.

Iron ore is found in Japan, but owing to its quality it has not been worked until recently. Of ordinary hardware, steel wire nails and common iron nails are imported in large quantities. That we can compete with European factories was satisfactorily proved by A. R. Whitney, Jr., of the nail works at Everett, Wash. That gentleman visited Japan and succeeded in securing several important orders.

For many years, in fact until quite recently, no competition was attempted with England in railroad material, locomotives, etc. The general opinion was, "we cannot do it", and when this fiat had gone forth no attempt was made to make an effort. In the meanwhile Japan is operating 3000 miles of railroad and constructing as many more. At last, after the world's fair in Chicago, the Baldwin Locomotive Works of Philadelphia, Pa., sent a former superintendent, Captain W. H. Crawford, to look over the field. That gentleman arrived in Japan and immediately claimed superiority for his engines over those of British manufacture in use on the railroads. The superintendent of the rolling stock, Mr. Trevithick an English gentleman, who had been in the railroad department since it was first started, not unnaturally denied this. To set the matter at rest, Captain Crawford proposed a test. This tickled the Japanese who appointed the Gotemba grade in the Hakone mountains as the place. This grade is very steep and about 18 miles long. The Baldwin locomotive walked away with the English engine, and since that time Crawford has sold over 120 of his locomotives to the Japanese government and private companies. It is the same with rails. Here too, the "we can't do it" acted as an effectual barrier. Yet it was only this year that the China & Japan Trading Company placed an order for 5,000 tons of rails with the Illinois Steel Company. The facts thus far enumerated prove sufficiently, I think, that there is a market, and a very promising one for all manufacturers of iron and steel.

But I wish to refer to another fact before drawing attention to the great changes that are being worked out day by day in that colossal inert mass called China. It is, that since the war, Corea offers a fair field for American enterprise. The concession for the railroad between Chemulpo, the port, and Seoul, the capital, a distance of about 25 miles, has been given to Americans. The French are building the much larger line between Seoul and Ginsen on the northeast coast. Since Corea can be reached only by way of Japan, the consideration of this promising market is pertinent here.

But the opportunity to establish a remunerative, new and growing market is in entering into direct communication with China; in other words, by imitating the Baldwin Locomotive Works and sending a trustworthy agent into the field. China has been rudely awakened by Japan in the late war, and it has been thundered in the ears of her sleepy and inert mandarins that unless she joins heartily in the march of progress her day of doom is at hand. In other words, that unless a new era is inaugurated the day of China's dismemberment is near. And they do, at least, understand this. Li Hung Chang was sent out to discover what it was that made those "foreign devils"

so powerful. He has reported, and now word has gone forth that we are no more to be interfered with; that we are a necessary evil, and that anything is welcome that promises a future settlement of accounts with the hated and despised "Wo jin" or pigmies, the name they unctuously bestow upon the Japanese. Hatred, passionate and deep-seated against their late conquerors, and fear of future chastisement, are the two motives that prompt the Chinese authorities to favor and foster internal improvements. Chang Chih Tung, the Viceroy of the two Kiangs, rich provinces near the mouth of the Yang-tsze river, has actually constructed railroad shops. They are located at Hankow, 400 miles up the river. Paul de Hees, a Belgian engineer of reputation, who had formerly been engaged in the construction of railroads in Turkey, was engaged by the Chinese government, and put in charge. Chang Chih Tung, who is Li Hung Chang's great rival in influence and wealth, decided that the railroad between Nanking and Peking, a distance of 1,407 miles should be built, but with Chinese money and under Chinese control. Although in charge of Belgian engineers, I know that many of them, and especially Mr. De Hees, are strongly in favor of American material and engines, and no better proof can be required than the fact that the Baldwin Locomotive Works obtained the contract recently for 12 engines for that road.

Concessions to Chinese merchants will be the order of the day before long, and I should not be at all surprised to see the time when the whole huge Empire of China will have a network of railroads. Are our manufacturers going to sit down quietly and see our cousins across the Atlantic monopolize this field? The Chinese are peculiar for their tenacity. Once accustomed to a special thing, it is a difficult matter to induce them to change. It is of the utmost importance, therefore, to be the first or among the first in the field, and the enterprise manifested by the Baldwin Locomotive Works is well worthy of commendation and congratulation.

If the late war and its results have been a rude shock to those loyal disciples of Confucius, the mandarins, the terms of peace insisted upon by Ito have proved a bitter pill. There is no man so quick to see an opening for turning an honest penny as the Chinaman, and Li Hung Chang owns, besides the large cotton mill in Shanghai, several other paying factories. Chang Chih Tung in 1894 purchased through van der Stegan & Co., of Shanghai a large cotton mill from Hetherington & Co., of Manchester, England. But the right to manufacture in China was too good a thing to be shared in by the people. The mandarins reserved it for themselves; not even foreigners were permitted to infringe upon it. Ito, the Japanese minister, ruined this paying monopoly. When he insisted on the session of the Liao Tung Peninsula with Port Arthur, he was afraid that Great Britain would object, and to propitiate that power, he added these two important clauses to the treaty.

1. That Japanese subjects have the right to manufacture in the open ports of China.
2. That Japanese goods imported into China shall be free from li-kin duty.

Marquis Ito was well aware that by the "favored nation" clause of her treaties with foreign nations no favor could be granted that was not shared by all alike. The first clause mentioned opened China to all foreigners who desire to improve the facilities of an illimitable labor market and wretchedly low wages (a Chinaman will work for 50 per cent less than labor is paid in Japan) of cheap coal and rapid transportation to all parts of the world at a low rate of freight. Manufacturing companies were organized at once. The American Trading Company of Shanghai built a cotton mill with \$1,000,000 taels (1 tael=73 cents) capital. Jardine Matheson constructed another. Factory upon factory is going up in Shanghai, and machinery and plants of all sorts are in constant demand. Recently a number of Frenchmen organized a company to build and operate a woolen mill with a capital of 10,000,000 yen (about \$5,000,000).

But it was the second clause quoted above that promises to enfranchise the Chinese in the interior from the disgraceful tyranny of their mandarins, while it has given an inconceivable impetus to importations of foreign fabrics. The tariff in China is almost uniformly 5 per cent ad valorem. That is, goods can be landed in China upon paying duty to that amount. As the Middle Kingdom has no railroads (Li Hung Chang's private road from Tientsin to Shan-hai-kwan and the Kaiping coal mines excepted), and the roads are not fit for travel, the rivers and canals are the natural arteries of trade. The mandarins here have appropriated the right to collect toll on all merchandise passing through their territory, and as these magistrates are very close together the frequency of this toll has acted practically as a prohibitory tariff. The abolition of this imposition, for such it was, has opened China. For, whereas formerly the consumption of foreign goods was confined to the territory adjacent to the coast, they are now placed on the markets of the interior, where wealthy and progressive Chinese are glad to purchase them. And China is rich. The mineral wealth, hitherto grasped by the mandarins, is being opened up; and it will not be long before machinery of all kind will be in demand to bring new sources of wealth from the bowels of the earth.

There are now six steamship lines, having an aggregate of 20 vessels, plying between the Pacific coast and China, calling at Japanese ports. They are the Pacific Mail Co. and O. & O. Co. (Southern Pacific), from San Francisco; Samuel Samuel & Company from Portland, Ore.; the Northern Pacific Steamship Company from Tacoma, Wash.; the Nippon Yusen Kaisha from Seattle, Wash.; and the Canadian Pacific Steamship Company from Vancouver, B. C. While the number of these companies proves the value

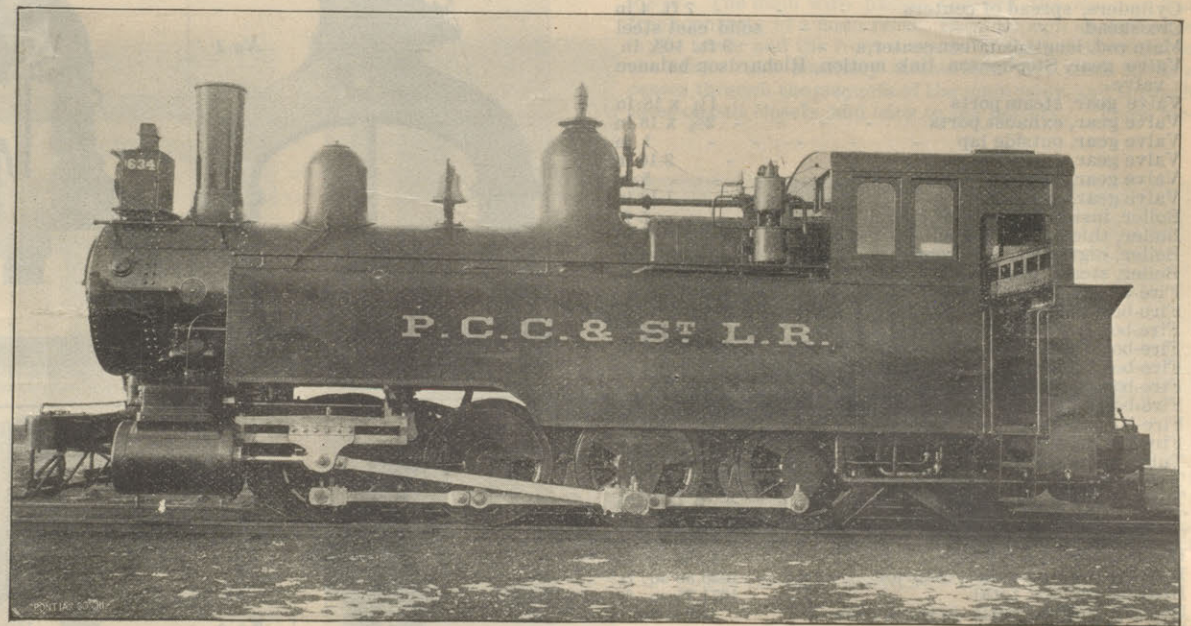
and extent of the Oriental trade, their competition has lowered freight rates to a remarkable extent. Raw cotton, to mention one instance, is carried from New Orleans to San Francisco by rail, transferred to steamers for Yokohama, and laid down in Osaka, Japan, at the rate of 60 cents per hundred weight. Besides these companies, the Perry and Barber lines of steamers from New York to Yokohama via the Suez canal, and calling at Chinese ports, carry freight at about one-half the rates charged by the overland lines. It is therefore not the freight that can act as a preventive to our competition.

THE MADISON HILL LOCOMOTIVE-P. C. C. & ST. L. RY.

Through the courtesy of Mr. S. P. Bush, superintendent of motive power of the Southwest System of the Pennsylvania Lines west of Pittsburgh, the illustration herewith and the accompanying description are given of an interesting locomotive which is also somewhat of a novelty. The engine was designed and built under the direction of Mr. Bush. The piece of track referred to is especially interesting because of the fact that it was operated as a rack road from 1848 to 1868.

This engine was especially designed for use on Madison Hill, Indiana, on the Louisville division of the Southwest System of the Pennsylvania Lines. The peculiar condition of the service at this place necessitated many departures from customary locomotive construction, and the proportions of the engine are consequently somewhat different from ordinary practice and do not entirely conform to the rules recommended by the Master Mechanics' Associa-

tion. The grade upon which this engine has to work, climbing and pushing with all the power of which its weight permits, and then coasting down again without steam, is one of the steepest in the world upon which a regular passenger and freight service is maintained with the sole aid of adhesive power. The length of the grade is 7,012 ft. and the total elevation is 413 ft., making a ratio of 311 ft. per mile, or approximately a 5.9 per cent rise. When ascending this grade the cars as a precaution in case of broken couplings, are pushed before the engine, and when descending the engine backs down preceding the cars. It is to be understood that the regular road engines are disconnected from their trains at the top of the grade, and left there waiting for the next train brought up by the hill engine.



LOCOMOTIVE FOR MADISON HILL INCLINE-P. C. C. & ST. L. RY.

In order to prevent the train from gaining too much headway during the descent the engine is equipped with an interesting arrangement for regulating the speed. This device is based on the principle of the Le Chatelier brake, and is in some respects similar to that used on several of the western mountain roads. It consists of connecting the valve chests with a 1½ in. pipe from which a 2 in. connection runs back to a point below the cab floor on the engineer's side where it terminates in a muffler. When descending the hill the link motion of the engine is reversed so that the cylinders during a portion of the stroke will force air up into the valve chests and from there through this pipe to the muffler where it escapes into the atmosphere. By means of a regulating valve below the cab floor the escape of the air can be checked so as to obtain the desired speed for the pistons and consequently for the engine. By closing the valve entirely the engine can be stopped during the descent. In order to

be under the same conditions as when going up a steep grade. The exertion of the full adhesive power is consequently not the exception but the normal condition of work on the Madison hill. To use steam expansively under these conditions would be impossible, unless the cylinders were of much greater proportions with regard to the adhesive weight than on the ordinary road engine. The total weight of the new engine is 140,000 lbs., all of which is adhesive weight, but the mean weight during the ascent is about 130,000 lbs., based on consuming two-thirds of the water in the side tanks in each trip. According to ordinary practice this weight would require a cylinder proportion of about 22x24½ in. The additional 3½ in. of the stroke which this engine has, is a clear gain in the expansion of the steam, over and above that which may be produced when the engine does not exert its full adhesive power up to the slipping point. In other words the cylinders were made as large as it was practicable to make them, and the economy of this is shown by the fact that ordinarily the engine is able to make three round trips up and down the hill without refilling its coal bunker which holds only a ton and half of coal.

The engine was placed in service the first of the year, and has been giving entire satisfaction ever since. No official test of its hauling capacity has yet been made, although it is the intention to do so in the near future in order to obtain reliable data for comparison and future use. It may be said now, however, that the engine has fully met the expectations of the officials of the road, and its performance during the ascent as well as the descent of the line is entirely satisfactory.

Quite a number of interesting details required con-

sideration in the design of the engine. In order to keep the front end of the top row of flues under water on the grade without filling the boiler so full as to cause the engine to throw water, the back end of the boiler is set considerably higher than the front end. The throttle valve is of the ordinary balanced type, but it has no play on its stem, the object being to avoid the clattering of the valve upon its seat in case the compression in the steam chest should exceed the boiler pressure during the descent. To protect the steam chests a relief valve has been placed on each, which is set to open just above the boiler pressure. In arranging the driving springs for the engine it was calculated that the front springs would receive the greatest load, and they were designed accordingly. When the engine is on the grade, however, its center of gravity is shifted backwards, and in consequence the rear springs receive the greatest load, which caused some little inconvenience at first. Instead of metallic piston rod packing, asbestos cord is used, as the metallic packing would be apt to be damaged when the engine is drifting down the hill without steam. The engine is equipped with a pneumatic bell ringer with pneumatic sand valves, steam heat for passenger trains, and all modern improvements. The principal dimensions are given in the following table:

General description: Tank locomotive, non-compound, standard gage.	
Fuel	bituminous coal
Driving wheels, number	8
Driving wheels, diameter	50 in
Driving axle journals	8 x 8½ in
Wheel base (all rigid)	15 ft. 3 in
Cylinders, diameter	22 in
Cylinders, stroke	28 in
Cylinders, spread of centers	7 ft. 4 in
Crosshead	solid cast steel
Main rod, length between centers	9 ft. 10½ in
Valve gear, Stephenson link motion, Richardson balance valve.	
Valve gear, steam ports	1½ x 18 in
Valve gear, exhaust ports	2¾ x 18 in
Valve gear, outside lap	1 in
Valve gear, inside lap	3-16 in
Valve gear, valve travel	5 in
Valve gear, lead	1-16 in
Boiler, inside diameter of barrel	5 ft
Boiler, thickness of sheet	7-16 in
Boiler, height from rail center	7 ft. 6 in
Boiler, steam pressure	150 lbs
Fire-box, Belpaire	
Fire-box, length inside	7 ft. 9½ in
Fire-box, width inside at top	3 ft. 11½ in
Fire-box, width inside at bottom	3 ft. 6 in
Fire-box, depth	4 ft. 9½ in
Fire-box, thickness of crown sheet	¾ in
Fire-box, thickness of flue sheet	¾ in
Fire-box, thickness of side sheet	5-16 in
Fire-box, grate area	27 sq. ft
Tubes, number	219
Tubes, diameter outside	2 in
Tubes, pitch	2 13-16 in
Tubes, length between tubes sheets	13 ft. 4½ in
Tubes, total area of tube sections	3.65 sq. ft
Heating surface, fire-box	142.86 sq. ft
Heating surface, tubes, exterior	1528.89 sq. ft
Heating surface, total	1671.75 sq. ft
Heating surface, ratio to grate area	61.91 to 1
Exhaust nozzle, single	
Exhaust nozzle, diameter	5 in
Smoke stack, minimum diameter	18 in
Smoke stack, height from rail	15 ft
Capacity of tanks	2000 gals
Capacity of coal space	3000 lbs
Tractive power, per pound mean effective pressure on piston 271 lbs.	
Tractive power, total with 30 per cent of boiler pressure	32520 lbs
Tractive power, total adhesive, at 25 per cent weight on drivers 35000 lbs	
Weight in working order	140,000 lbs

The M. C. B. INTERCHANGE RULES.

A circular has just been received from the secretary of the Master Car Builders' Association announcing that at a meeting of the arbitration committee, held November 6, 1896, the following subjects were brought to its attention by correspondence from the members of the association, and were considered worthy of a ruling in accordance with the instructions from the association that the arbitration committee should make a ruling on questions arising and not settled by the rules, which ruling should stand as a part of the rules for the year:

E. When air brake hose is missing it is evidence of unfair usage, and the cost of replacement is chargeable to the party having possession of the car.

F. There seems to be some misunderstanding also in regard to Section 39 of Rule 3, Sections 15 and 16 of Rule 4 and Section 5 of Rule 5. The arbitration committee rules that a proper understanding is as follows:

It is the intent of the rules that a repair card should be used in all cases when repairs are made, whether such repairs are made right or wrong, or whether they are to be charged to the car owner or not.

A company making wrong repairs, whether of owner's defects or not, becomes responsible for making the repairs right. When such wrong repairs are made of owner's defects, bill may be rendered against the owner for the wrong repairs the same as if they had been correctly

made, but an M. C. B. defect card must be attached for wrong repairs, which will be used as a basis of a bill against the party making the wrong repairs.

G. Section 14 of Rule 5 reads: "When draw-bars, knuckles, hose or brake beams are replaced under conditions which make them chargeable to the owner, new material must be used." This paragraph was introduced at the convention as an addition to Section 13, although given a new section number. The arbitration committee believes that by "draw-bars" it was intended to mean "M.C.B. draw-bars," and its decision is that the letters "M.C.B." should precede the word "draw-bars" in this section. As further justification of this ruling, it calls attention to the fact that ordinary link and pin draw-bars are almost necessarily second hand material.

MODERN IRON WORKING APPLIANCES.

IV.

POWER HAMMERS AND HAMMER CRANES.

There is probably no other one department in railway and manufacturing establishments where so great progress has been made in methods of doing work as in the blacksmith's shop. It has been only comparatively few years since the greater part of the work in connection with car departments was done by hand with the hammer and anvil, but to-day

the piston. The working valve is in perfect balance and the customary practice is to operate the machine by hand. The illustration does not show the anvil, but this is of the ordinary type with a removable cap. It will be noted that the columns of the hammer are of the box form which gives the maximum amount of rigidity, which is always an important feature in a machine of this class. This form also gives a design of pleasing, massive, and substantial appearance.

No. 2 shows a common form of hammer which is exceedingly useful about railway shops. This machine is made in 17 different sizes ranging from 500 to 30000 lbs. The illustration shows a 2500 lbs. hammer which has cylinders 14 x 36 in., the distance between guides being 19 in.; between frames 6 ft., width over all 8 ft. 11 in., height from the floor 14 ft.; height from the floor to the bottom of guides 47 in.; die face 10 x 18½ in., weight without the anvil 19000 lbs. and with the anvil 35000 lbs. The machine is built with or without adjustable guides as desired. The valves are balanced, the valve gear is simple and substantial, taking up its own lost motion as wear takes place. Steam is admitted both above and below the piston and the operator has accurate control of the character of the blows given. The smaller sizes are usually built to work automatically but

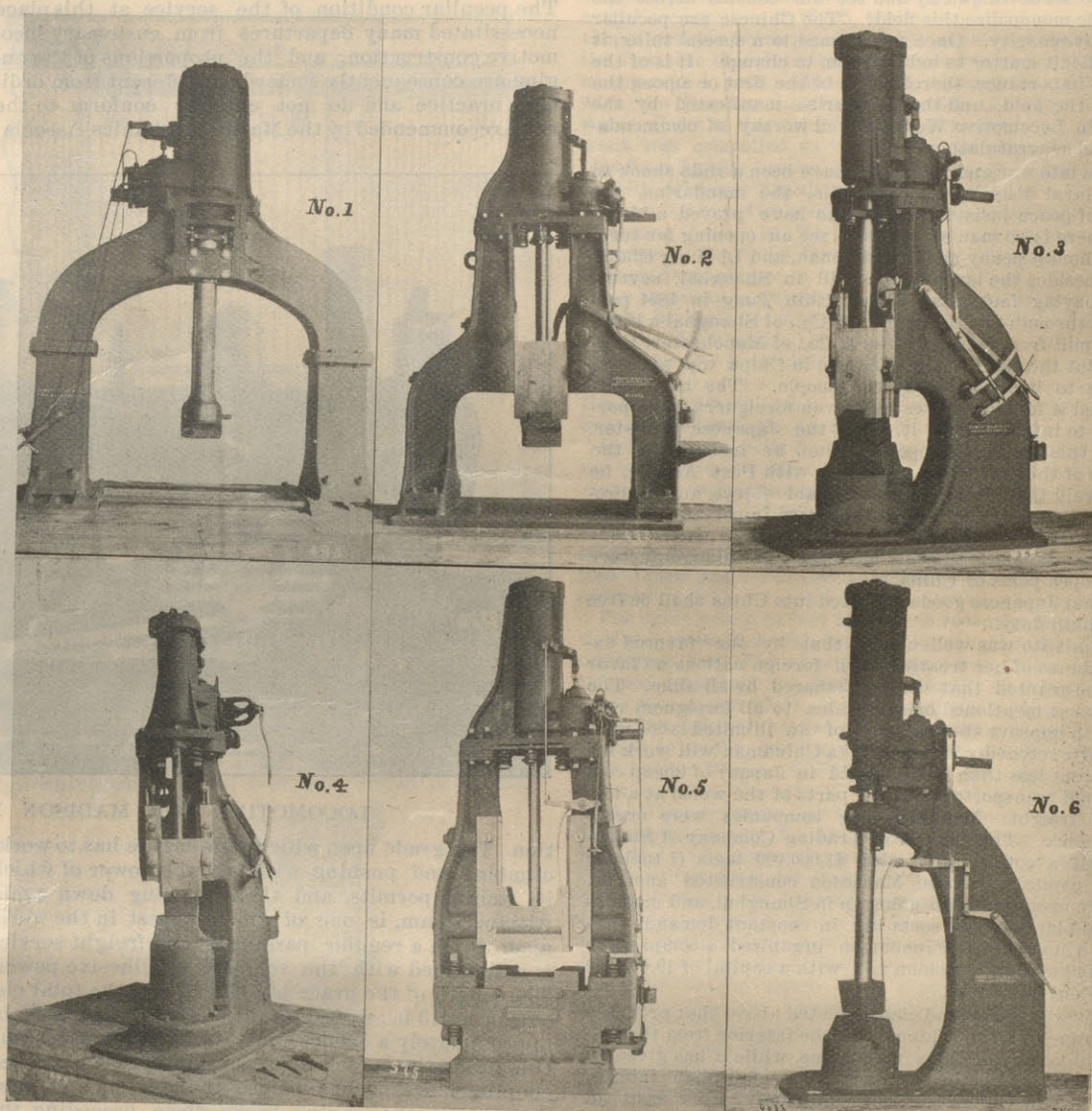


FIG. 19—STEAM HAMMERS BY BEMENT, MILES & CO.

we find that practically every piece of forgin which enters into the construction of a railway car is made under the power or drop hammer with the result, that the cost of such work has been reduced to figures which were formerly considered impossible. The form of machinery used however in this branch has changed very little except that there has been a general tendency in this as well as in all other lines, to make it heavier and more powerful. In the accompanying illustration Fig. 19 will be found a number of the types of hammers in general use as manufactured by Bement, Miles & Company Philadelphia, Pa. Hammer No. 1 is intended for heavy forgings which require an unusual amount of space about the anvil. This hammer is made in five different sizes, viz. 4,000, 6,000, 10,000, 15,000 and 20,000 lbs., the figures referring, as usual, to the actual weight of the falling parts. Steam is taken both above and below the piston and one of the special features consists of an adjustable guide for taking up wear of the piston rod. It will be noted from the illustration that this rod is placed between the frames and close up under the cylinder leaving a space below, which is equal to the entire stroke of

in the larger ones this is not customary and in such machines the uprights are divided so as to give working space at the sides as well as at the front and back. This is a design of hammer which has met with great success owing to the fact that it can be adapted to a large variety of work and is particularly useful in shops where a sufficient number of duplicate pieces are not turned out to warrant the expenditure necessary for putting in a drop hammer, as this machine can be adapted to doing the class of work which is generally performed by that type.

No. 3 shows a 2500 lbs. single standard hammer having a cylinder 14 x 36 in.; the distance between the guides being 17½ in. The height under the guides is 47 in.; the height over all 13 ft. 9 in.; base 4 ft. 9 in. by 7 ft. 4 in.; die face 17½ x 17 in.; weight without the anvil 21,800 lbs. and the weight with the anvil is 41,400 lbs. The standard of this machine is of the box type and the guides are adjustable. It takes steam both above and below the piston. The ram and guides are set diagonally to the frame at the proper angle for drawing and finishing. The valve gear is simple and substantial and can be operated automatically or by hand, giving every desired vari-

ety in length, position, rapidity and force of blows. The anvil is made with a removable cap which can be renewed without disturbing other parts of the hammer, and in order to facilitate this operation, the frame is curved downwards to the base plate, and stiffening ribs are extended below the floor line in order to maintain the rigidity of the machine.

No. 4 shows a 250 lbs. single standard hammer with adjustable guides. The cylinder is 5 x 16 in.; the distance between guides is 7½ in.; the height over all 7 ft. 8 in.; the base 29 x 44½ in.; the die face 4 x 7 in.; the weight without the anvil 3000 lbs. and the weight with the anvil 4750. This is a very convenient type of hammer for small work and one which can also be used for drop forging and die work as well as for drawing and finishing.

No. 5 is an illustration of a 1500 lbs. steam drop hammer which is one of the most useful machines found about blacksmith shops where large quantities of duplicate work must be turned out at a small cost. Steam is admitted both above and below the piston and the blow is governed by means of a foot treadle, the piston always returning to the top of the cylinder after each stroke and remaining there, giving the operator a chance to change the work. The dimensions of this machine can be altered to suit different classes of work but the standard machine has a cylinder 10½ x 42 in.; the distance between guides being 20 in.; the distance between the frames 30 in.; the die face 16 x 20 in.; the height of the machine over all 14 ft. 4 in.; the steam pipe 2½ in. in diameter; the exhaust pipe 3 in. in diameter and the weight of the machine is 26000 lbs. Adjustable guides are provided for taking up wear and the ma-

The power for raising and lowering is applied by a hydraulic cylinder located between the two channels which form the columns

AN OLD AND A NEW INTERLOCKING PLANT.

A paper was read before the Railway Signaling Club by Mr. A. H. Rudd, of the New York, New Haven & Hartford Railroad at the November meeting, of which the following abstract gives the chief points of interest:

In 1852 the New England Railroad crossed the New York, New Haven & Hartford Railroad at grade, near Hartford, Conn., the crossing being governed by the familiar red ball hoisted on a pole. In 1870-71 both roads were double-tracked and a new device was installed which governed trains by a combination of a disc on top of the tower, and by the lights through windows of the tower itself. In June, 1883, the Pennsylvania Steel Company installed one of its machines, which was used twelve years with hardly any repairs, and with little inspection. Its only counterpart exists, I believe at Hagerstown, Md. In 1896 it was found necessary to build a more modern plant and the first "National" machine of 1896 was put in, and has attracted considerable attention. It is built by the National Switch & Signal Co., of Easton, Pa. I believe it is as nearly perfect as one can be made. A description of it appeared in the Railroad Gazette of August 14 and in the Railway Review of May 16, 1896. "Union" patent rocker shafts are used in the lead out. One "National" switch and lock movement is used operating two siding derrails. At all other points we have employed the "Union" facing point lock, the lock rod being provided with a screw jaw adjustment, and the front rod with slotted lugs of my own design, which permit the rail to travel considerably without causing trouble. For ordinary use a ¼ in.

in. deep, and filling them with concrete well puddled and tamped during the operation. In addition to substituting movable point frogs for the stiff ones, four sets of slips were put in.

Not a switch has yet been run through or damaged. The authorized speed of all trains over the junction is eight miles per hour, and the average number of train movements is, from 8 a. m. until 4 p. m., 101; from 4 p. m. until 12 midnight, 82; 12 until 8 a. m., 57. The greatest number being 11 from 6:30 to 7 a. m.; 9 from 7 to 7:30 a. m.; 10 from 8 to 8:30 a. m., and 13 from 2 to 2:30 p. m.

The electrical part of the work has some new features. West-bound Valley trains are rung in from a Hall track instrument, all others from push buttons in switch or crossing gate cabins. Repeaters are operated by the distant signals. When the signal is at caution, the circuit is closed through a single contact commutator, and the indicator shows caution when the signal is cleared, the circuit is opened and the repeater shows clear. Obviously, only failure of the current drops the indicator to clear. Electric locks of the Hansel patent are used in such a manner that the lever can be put home at any time, but while any wheels are on the track circuit between the distant signals and the frogs, the latch cannot be put normal, the result being that the route cannot be changed until the train is over the interlocking.

On the Hartford division also a block system has been put in service during the past two weeks, which we consider the equal in economy, efficiency and elasticity of any now in use. The Hall signals are extensively used on this division, and the blocks immediately in the rear and advance of the interlocking are protected by them—the problem was to interlock them with the tower. Taking, for example, the east-bound track, the method is as follows:

A banjo signal in the rear of the distant signal is set by its own track circuit, and held set also by the circuit previously referred to, between the distant signal and the frogs. The main battery for this banjo signal is in the tower. The main wire passes through the magnets and front contacts of a main relay, then through an indicator in the tower and the front contacts of the track relays to the banjo. An auxiliary circuit from the same battery passes through the magnets of the main relay, and through three circuit closers, and back to the battery. These cir-

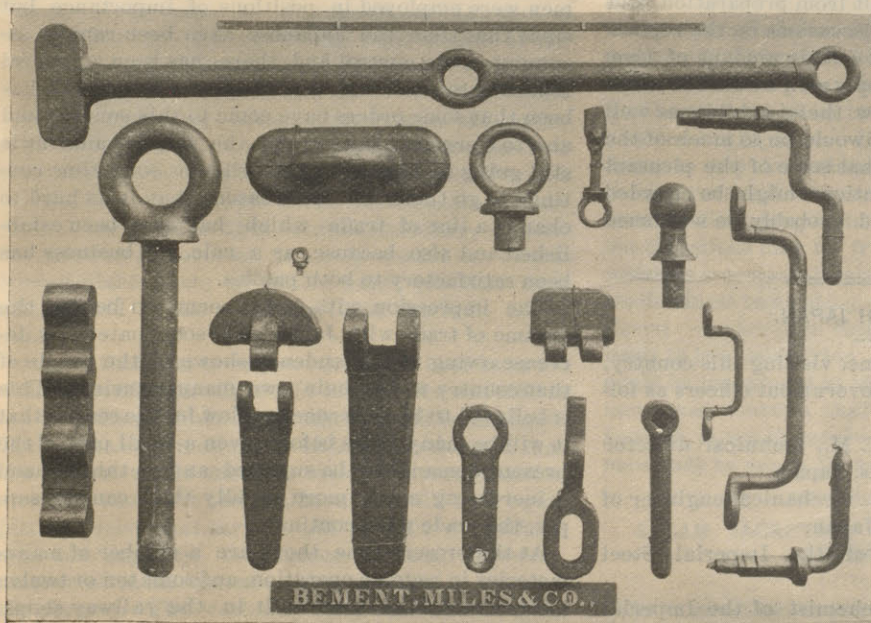


Fig. 20—SAMPLES OF DROP FORGINGS.

chine is also equipped with taper shoes for matching the dies. A fair idea of the variety of work which can be performed on a machine of this character is given by the illustration Fig. 20 which is reproduced from a photograph of a collection of forgings made on one of them. It will at once be seen that a machine such as this is extremely useful in a car shop.

No. 6 is reproduced from a photograph of a special 1,600 pound steam hammer designed for welding locomotive frames and similar work. The machine has an extra long stroke, that is 45 inches, and the guides are placed close up under the cylinder, being made adjustable and leaving a space above the anvil equal to the whole stroke. Steam is admitted both above and below the piston and the valve gear takes up its own lost motion and operates either automatically or by hand. The operating mechanism places the machine absolutely under the control of the operator and gives him the power to produce any desired force of blow. The anvil is detached and has a movable cap. The weight of the machine complete with the anvil is 26,000 lbs., and it is well adapted to any class of irregular forging such as cranks, marine rudders, etc.

All of the hammers illustrated herewith are of types which have been in service for many years, but each of them has been subject to improvements in details from time to time as suggestions have come up arising from experience in their operation. In Fig. 21 will be found a type of hydraulic jib crane which has been found to be a convenient accessory to hammer plants, using moderately heavy machinery. The crane illustrated has a capacity of three tons and the design is manufactured by Bement, Miles & Co. in capacities to suit requirements. The crane is so extremely simple as to need no detailed explanation.

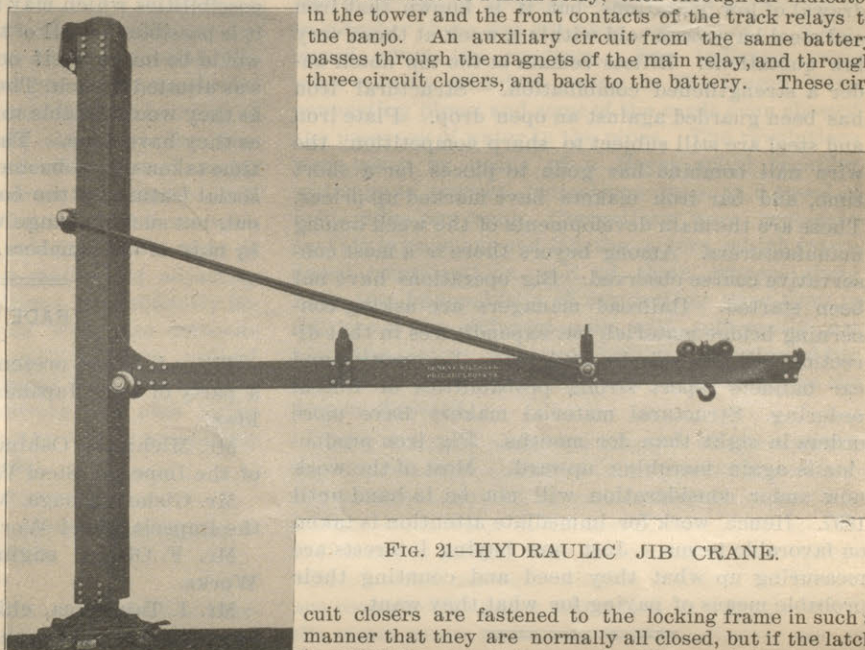


Fig. 21—HYDRAULIC JIB CRANE.

cuit closers are fastened to the locking frame in such a manner that they are normally all closed, but if the latch is pulled the circuit is opened. The result is that with the levers normal, the main relay is always closed, and the banjo operates on the well known track circuit principle. Should, however, either of the levers be pulled, the banjo is still clear, as it holds its main relay closed until a train strikes the circuit, when the main relay is opened and cannot be closed until the auxiliary circuit is again completed by restoring the semaphore to danger. However, before the latch can be put down far enough to close the circuit closer it is locked by another "Hansel" lock operated on a track circuit extending from the north side of the frogs to the next banjo. It appears, therefore, that after the rear banjo has been set by a train, it cannot be cleared until the train has passed inside the home signal. This home signal latch cannot be put normal until the rear of the train has gone onto the frogs, and when it is restored it is locked as soon as the front end of the train has cleared the frogs, and held so until the rear of the train is protected by the advance banjo. A third "Hansel" lock included in the main circuit of the advance banjo, is applied to distant signal No. 1, so that if the banjo is set the plunger is inserted, and No. 1 cannot be cleared as long as seventy-eight's circuit is open.

Engineers' Society of Western Pennsylvania.

At the November meeting of the Engineer's Society of Western Pennsylvania a paper was presented by Mr. Diescher on "Inclined Plane Railways." In it the various types of inclined planes engaged in the transportation of commodities, teams and passengers, their respective modes of operation were reviewed. Efficiency, hoisting plants, drums, safety apparatus and safety ropes were each treated and also appliances for the control of the operation and for the prevention of accidents. Wire ropes also received attention with reference to their composition, durability, strength and causes and effects of wear. The history of a particular set of wire ropes in service on a team inclined plane were given, as well as tests of original wires, of finished new rope, records of gradual deterioration of that rope and tests of the same rope after being thrown out of service on account of advanced wear.

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CHICAGO, SATURDAY, NOV. 28 1896.

THE anticipated expansion of the iron trade which was so confidently predicted a few weeks ago has not begun, but there has been a general covering of requirements in a small way. This, with the anticipations of further improvement, has led to the withdrawal of low quotations, but it is known that iron and steel have been sold within a week at these very low quotations. Billets remain at the top notch under a strengthened combination. Structural iron has been guarded against an open drop. Plate iron and steel are still subject to sharp competition; the wire nail combine has gone to pieces for a short time, and bar iron makers have marked up prices. These are the main developments of the week among manufacturers. Among buyers there is a most conservative course observed. Big operations have not been started. Railroad managers are asking concerning bridge material, but expenditures in that direction will probably be moderate. Locomotive and car builders report strong probabilities of liberal ordering. Structural material makers have more orders in sight than for months. Pig iron production is again marching upward. Most of the work now under consideration will not be in hand until 1897. Hence work for immediate attention is taken on favorable terms. Just now buying interests are measuring up what they need and counting their probable means of paying for what they want.

THE organization of iron workers known as the Amalgamated Association of Pittsburg, has after a lapse of about two years officially declared the "strike off" at the plant of the Tudor Iron Works in St. Louis. The works have been in continuous operation from within a short time after the strike commenced, a sufficient number of men not bound by rules of the association being available. The only effect of the declaration is to permit union men to obtain work in this plant without forfeiting their membership in the association. In other words, the organization after a delay of two years tells its members they are at liberty to go to work again for the Tudor Iron Works. But how about the owners of the works who have all this time been prevented from hiring these men. Will they acquiesce in the decision of the association and allow the men to resume work?

Workingmen like other men, are slow to learn lessons when their passions and prejudices are allowed to influence their judgment. The tyranny of capital has been a favorite phrase with the so-called friends of the workingman, but it is more than doubtful if capital ever exercised the degree of tyranny that is manifest in the rulings of labor organizations. So long as men are deprived of the right to exercise their own will in the matter of employment, it matters but little from which side the restraint comes. Labor organizations are capable of being made a power for good but as at present conducted, many of them create a greater evil than that which they seek to overcome. The solution of the labor problem, lies in the harmonizing of the interests of the employer and the employee. These interests have un-

fortunately been allowed to drift apart. The question of blame for this condition is about equally divided, but the matter will never be settled by warfare.

IT HAS been suggested that the two entirely separate conventions of the Master Car-Builders' and the Master Mechanics' Associations might be arranged so as to hold both of them during the same week. The members and others who attend the conventions are scattered over such an extent of territory as to cause a considerable loss of time in traveling to and from the meeting place; and this together with the time spent at the meetings themselves fills two weeks, and in some cases more time than that is taken up. It is so important for members to be there that few if any complain of the time taken from business, yet it would seem to be possible to decide upon a plan whereby both conventions might be held in four or five days. This might be done by holding the meetings of one association in the forenoons and the afternoons might be given to the other one. There are many advantages which appear to recommend such a scheme, among which may be mentioned the saving of time and of money, the bringing together of the members of both associations and the value of treating allied subjects almost simultaneously. The necessity of getting through with the business of a convention within a certain time cannot fail to promote prompt businesslike methods and to encourage preparation for each subject which is taken up. The pointed and vigorous topical noon-hour discussions of the last Master Car Builders' convention show the possibilities which may result from preparation, and it is possible that all of the discussions on the reports would be improved if only a certain amount of time was allotted to each. The supply men would not suffer as they would be able to show their exhibits as well as they have done. There would be so much of the time taken up by business that some of the pleasant social features of the conventions might be crowded out, but such a change would probably be welcomed by most of the members.

TRADE WITH JAPAN.

There is at the present time, visiting this country, a party of four Japanese government officers as follows:

Mr. Michitaro, Oshima, K. M., technical director of the Imperial Steel Works, Japan.

Mr. Gisho Yasnaga, M. E., mechanical engineer of the Imperial Steel Works, Japan.

Mr. F. Obana, engineer of the Imperial Steel Works.

Mr. J. Takayama, chief chemist of the Imperial Steel Works, Japan, and chief examiner of the department of patents. Accompanying the party is Mr. K. Komura, of the Kamaisha Iron Works of Japan.

These gentlemen have been sent out by the Japanese government for the purpose of making a careful investigation of the methods used in the manufacture of steel in different parts of the world. In addition to visiting this country, they will make a tour through Europe, and in each country will carefully investigate the different steel making plants. They will then employ engineers for designing steel works for their own country and purchase the necessary machinery, appliances and outfit complete for the erection of such works. The location of the plant has been selected on the Inland Sea in the southern island and near the great coal fields of Japan. This coal is well adapted for the manufacture of coke, and this industry is at the present time carried on quite extensively, the product being used by iron foundries and manufacturing establishments. The iron ore deposits in the country are quite extensive and being located in the northern part of the central island and near the sea coast, it may be transported from the mines to the steel works by water. There are extensive deposits of lime stone in the country the quality of which is fairly good for the manufacture of steel, and fire brick are already being manufactured and used for iron foundries, etc. At the present time there is one blast furnace in operation and the pig iron produced is used in general lines of manufacture and the railway shops, in which all the castings used by the railway companies are now produced. It is the intention of the company to build new blast furnaces and also a

Bessemer and open hearth steel plant and mills for rolling steel rails and merchant bar.

The commission will require about one year's time for making its investigations so that it will probably be some time before ground is actually broken for the erection of the plant and it is pretty safe to say that it will be two or three years before any regular output is established. In view of this fact it behooves the American manufacturers to do everything in their power to aid the Japanese government in the establishment of its plant. That this plant is to be established is beyond a doubt, but to some extent its successful operation is problematical. During the planning and erection of the plant and for the work itself, the Japanese government as well as private companies will require a large amount of machinery and raw material, and the country which comes into the closest touch with the Japanese during their investigations, will undoubtedly receive the greater bulk of these orders. Should it afterward be found that the character of the material available in Japan is unsuitable for the work or that the quantity is insufficient, raw material must be imported in greater or less quantities and this trade will be found worth looking after.

Many conflicting reports are being circulated regarding existing conditions and the possibilities of trade with Japan are being canvassed, but, as near as can be determined, the facts with regard to heavy machinery and railway equipment are briefly as follows: Until about two years ago all of this trade went to England for the reason that many Englishmen were employed in positions of importance, but since that time the Japanese have been rapidly assuming entire control and there has been a general tendency to seek the best market. The result has been that some orders have come to this country and also to Germany, but by far the largest amount is still going to England, and will for some time continue to go there for the reason that it is hard to change a line of trade which has once been established and also because, as a rule, the business has been satisfactory to both parties.

The impression with some seems to be that the volume of trade with Japan will soon materially decrease owing to the tendency shown by the people of that country to do their own manufacturing. This is believed to be an erroneous view for the reason that it will be many years before even a small part of the present demand can be supplied and as this demand is increasing much more rapidly than can the supply, the trade must continue.

At the present time there are a number of manufacturing factories in regular operation, and some ten or twelve locomotives have been built in the railway shops, but during the time required for their construction at least two hundred and fifty, if not three hundred, were imported. Some wood working machinery has been built in that country, but for every one of these machines it is safe to say that fifty have been purchased. At the present time plans are on foot which will require twenty-five or fifty machines and locomotives for every one which can possibly be built in that country. The stories about watches, bicycles, etc., being manufactured in Japan and imported into this country at prices lower than they can be made here, are all pure fabrications, having no foundation whatever. It is not unreasonable to suppose that this may some day be done, but this line of business will be well developed before the manufacture of steam engines, locomotives, and heavy tools has secured even a slight foothold.

Some short sighted manufacturers in this country are standing in their own light by refusing to give information to the Japanese because they fear their designs will be copied. It is not improbable that some have been duped into this position by competitors who wish themselves to secure favor and get some business. The Japanese are not the sort of people to be turned from their purpose by such a slight obstacle as the refusal of a permit to walk through a shop; but such a refusal would with many of them preclude any possibility of business, no matter how good the prospects might have been before such refusal. The Japanese are themselves so very courteous that an affront or lack of civility, which to us would seem insignificant, is easily interpreted into a very serious affair. The visit of the gentleman referred to gives the manufacturers of this country an opportunity for laying a foundation

which may result in some good business for them, and it is hoped they will improve it.

THE LARGE CAR PROBLEM.

A very large amount of thought, time and effort has been devoted during the present year, to say nothing of previous years, to the solution of the large car problem, so called. Traffic officials, classification committees, and railway clubs, have had the question under consideration, but to little purpose except the gathering together of all the definite information obtainable on the subject and the formulating of opinions by those more or less qualified to express them. Various writers have taken occasion to air their views as to possible solutions of the question, but nothing as yet appears to have been evolved that is in any degree satisfactory. A lengthy discussion of the subject by Mr. E. W. Judd, has recently appeared in the *Railroad Gazette*, but although the latest, it is nothing in advance of the articles that have previously appeared.

It may, perhaps be of some advantage to fix clearly in mind, the genesis of the difficulty. With the development of our railroad system, has come by the most natural process, two variables which are responsible for the confusion which exists. On the one hand are the freight cars with their almost numberless differences in width, height, cubic contents and carrying capacity; and on the other is a classification of articles to be transported in such cars, which is fully as heterogeneous in its makeup. The one is the result of an attempt on the part of the mechanical and operating departments of the railroads to meet operating requirements with a minimum outlay for a maximum result without regard to traffic conditions, or consultation with the traffic men; and the other is the outcome of competitive conditions modified by individual preferences obtained wholly without reference to the mechanical and operating departments. It is natural, therefore, that under such circumstances, not only should an almost irreconcilable state of affairs exist, but that each side should in the main attribute the fault to the other.

It is of little use to review the steps that have led to such confusion. It would be easy for one side to say that the methods of the other should be changed. The mechanical men might with justice demand that the present traffic methods should be recognized to meet the case; but the traffic men could with equal justice insist that cars should be built of uniform size and capacity. As matter of fact, however, neither of these remedies are possible; at least for the present. The variously sized cars will continue to run and the unscientific and unjust classification will continue to be used; so that in whatever remedy is proposed, account must be taken of these two factors.

Aside from a few minor questions of operating, such as increased danger to trainmen, because of the variation in height of cars, etc., the difficulty to be removed, is altogether on the traffic side of the subject. It grows out of the fact that under present arrangements, cases of discrimination more or less severe, are frequent. The present arbitrary minimum weights which are assessed upon light or bulky articles necessarily produce a wide difference in rate per hundred pounds, varying according to the size of cars furnished. It is to be said that traffic men have done their utmost to minimize this inequality, but so long as the prescribed car load minimum on any article is greater than can be loaded into the smallest car in general use, so long must these inequalities in rate continue. What is needed is something that will effect an equalization of charges, so that the shipper who is furnished a thirty thousand pound car of small cubic capacity, will not be compelled to pay a higher rate per hundred pounds than a competitor in the same line who is furnished a sixty thousand pound car with double the cubic capacity.

It is fair to infer that in fixing the minimum weights to be applied to car loads of different articles, reference was had to earnings. That is to say, that the minimum weight taken in connection with the rate, was assumed to give the proper revenue for the transportation of a car load of average dimensions. It is of course understood that the prescribed

minimum was in no case to be interpreted as determining the weight to be charged for in every case, for whenever the actual lading exceeds the minimum, the extra weight is to be paid for at the regular rate. It is this last condition that offers a possible clue to a solution of the difficulty. Investigation in connection with this matter, has made known the weight per cubic foot of practically all light and bulky articles offered for shipment. Few, if any, cars less than 28 ft. in length, are now in general use upon the railroads and it would be comparatively easy matter to determine from the cubic capacity of such cars, the rate that would give the required revenue upon a car load of any given article loaded in such cars. When this is ascertained, minimum weights for such articles, could be abolished and the car load rate thus determined could be applied to any car regardless of size, *provided it was full*. It may be objected that this plan contemplates the employment of the entire cubic capacity of cars in every case. This would be the ideal condition; but it would probably have to be modified, so as to permit the car load rate as above determined, to apply on large cars even where they were not altogether full. This could be easily provided for by a series of minimums for the various sized cars below which the car load rate would not apply.

The effect of such a plan would be to establish an absolute equality of rates as between all shippers of the same classes of goods. It would also make it out of the power of any traffic man to favor particular shippers and wholly remove the present feature of discrimination which has been the cause of so much complaint. Under such a rule, the mechanical departments of the roads could proceed to develop the most satisfactory car from an operating standpoint for there would be no inducement for the building of abnormal equipment. It would also have the tendency to stop the building of a certain class of special private cars and thus remove from the situation still another disturbing feature. That the plan is not without objections may be freely admitted; but that it presents a comparatively easy method of adjusting the business to existing conditions, is confidently believed. A thorough familiarity with rate methods leads to the conviction that nothing more radical could be introduced at the present time. Indeed it is more than doubtful that admitting the plan to be feasible, it would receive the unanimous acceptance necessary to secure its adoption.

STEAM JACKETING AND SUPERHEATING IN LOCOMOTIVES.

An interesting contribution to the scientific literature upon locomotive designing has been made in a paper which was read November 4, before the Institute of Mechanical Engineers of London by Prof. T. Hudson Beare and Mr. Bryan Donkin, the chief details of which were recently published in *Engineering*. The experiments which formed the basis of the paper were carried out upon a locomotive upon the Lancashire & Yorkshire Railway of England. The cylinders were inside the frames and were 19 x 26 inch in size, bushed down to 17½ inch by a liner which gave a ½ inch space for the jacket steam. The heads of the cylinders were also steam jacketed in the covers, but the exterior surfaces of the jackets were not well protected, but were considerably exposed to radiation, and from remarks made in the discussion it appears that the drainage of the jackets was not by any means perfect. The data were taken on four runs between Manchester and York, a distance of 76 miles. The feed water was measured by a meter placed upon the suction side of the feed pipe. The performance of the cylinders was figured from indicator cards, and records were taken of gas and coal analyses. The results were not such as to appear to justify considering them as conclusive, although they were based upon as accurate data as can be taken from locomotives upon the road, which is equivalent to saying that they are practically useless, and it is a pity that foreign engineers with all of their care in testing should not yet have awakened to the fact the only satisfactory way to test a locomotive is to put it upon a stationary testing plant.

Briefly stated, it was found in two runs from Manchester to York that when the cylinder jackets

were in use there was a consumption of 24.49 pounds of steam per indicated horse power per hour, and that on runs without the jacket there was a consumption of 26.7 pounds of steam, which showed a saving of 8.3 per cent for the jackets. In the remaining trips the jacket showed a consumption of 24.48 pounds against 24.87 pounds or a saving of 1.5 per cent by jacketing. In the first two runs an increase of fuel economy of 5 per cent was obtained for the jackets. The average speed was the same in the runs with and without the jackets. In the second two runs the record for the jackets was much poorer than in the others, the coal consumption per horse power per hour being 10 per cent greater in the jacketed than in the non-jacketed runs, the weight of the train being the same but the speed being three miles per hour higher in the non-jacketed runs, which greatly increased the horse power developed. Inasmuch as jacketing is of doubtful value even in the stationary practice with low piston speeds and where data can be taken with suitable accuracy, it is not to be wondered at that the results of road tests upon locomotives should not show any satisfactory advantage for the jackets. There are some points in which the experiments are open to criticisms which merit notice in passing. The water of condensation in the jackets was collected in receptacles which were located so as to cause one of the contributors to the discussion to raise the question as to whether the cylinders were not jacketed with water instead of with steam. The fact that the water meters were used is itself enough to justify distrust, and being placed in the suction side of the boiler feeders brought out a question as to whether there was not some leakage of air which would affect the readings. The indicator cards were open to criticism owing to the length of the connecting pipes, and some of the cards even showed the presence of water in the pipes. The revolutions were taken by means of a Boyer speed recorder which gave correct indications only at a speed of forty miles per hour. Corrections were necessary for this instrument and for the meters, which introduced complications. All of these matters along with the impossibility of duplicating conditions in any two of the different runs will sufficiently explain the reason for questioning the value of the conclusions which may perhaps be drawn from the figures obtained.

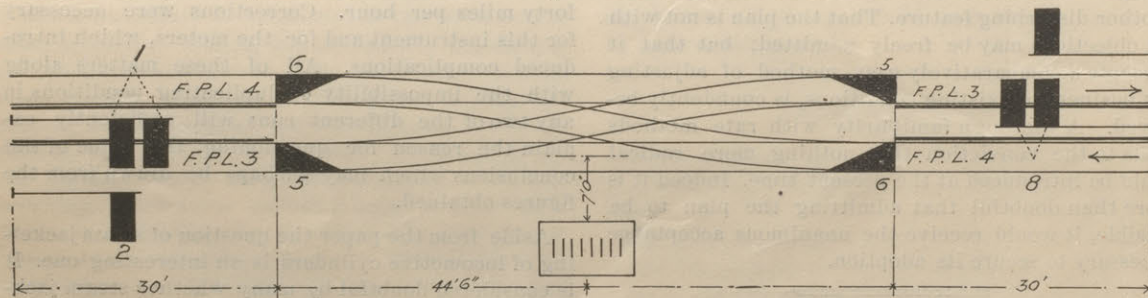
Aside from the paper the question of steam jacketing of locomotive cylinders is an interesting one. It is considered doubtful by many whether steam jacketing is worth while in the case of slow piston speeds. If it is not in such a case increasing piston speeds will not mend matters. Engine builders in Europe are recommending live steam jackets through which the steam passes on its way to the cylinder, one of the advantages claimed being perfect drainage and the prevention of pocketing air as well as obtaining the highest possible temperature of the steam unless it is superheated. From recent experiments upon the transmission of heat through metallic cylinders, emphasis is placed upon the importance of perfect drainage of jackets, and it is stated that a layer of water upon the surface of a cylinder adds as much to the heat resisting property of the cylinder as would the same thickness of metal itself. It is impossible that more than a comparatively small portion of the volume of steam in a cylinder should come into contact with the cylinder walls, and especially at high speeds, it is difficult to see how jacketing with boiler steam not superheated can do more than to increase the minimum temperature of the cylinder walls. Jacketing with steam superheated to a high degree would probably prevent cylinder condensation to some extent, and it has been shown that jacketing with hot smoke-box gases gives a saving (see *RAILWAY REVIEW* of January 19, 1895, page 33), and with no great expense. Superheating would seem to offer a much more promising field, however.

There is perhaps no factor more potent than cylinder condensation in bringing down the economy of the steam engine. Thurston says that the loss from initial condensation as taken from data from a large number of engines is thirty-five per cent. Other authorities state the loss to vary between fourteen and forty-two per cent, with cut-offs from one-half to one-twentieth of the stroke. Condensation will therefore bear looking into, and one of the easiest of the protective measures is the asbestos jacket for chests

and cylinders. The most desirable preventive is superheating, and he who applies it satisfactorily to locomotives will be worthy of praise. It would be venturesome to suggest methods of accomplishing it at this time, beyond remarking that a superheat of twenty or thirty degrees would be a highly important gain which would seem to be possible to obtain from the hot smoke-box gases. A superheat of one hundred degrees would probably do away with much of the initial condensation, and Longridge believes that a superheat of 400 degrees will prevent it entirely.

INTERLOCKED CROSSOVERS—UNION LOOP RAILROAD, CHICAGO.

The plan of tracks and junctions for the Union Elevated Loop Railway in Chicago, was shown in the RAILWAY REVIEW of August 22, of the current volume, and through the courtesy of Mr. Chas. Hansel, C. E., vice president and general manager, and Mr. H. M. Sperry, signal engineer, of the National Switch & Signal Company, a plan of the crossover switches, which are to be used in connection with this loop is illustrated herewith. The purpose of these diamond crossovers or crossings is to provide means whereby the four roads using the loop may each be able to use the downtown tracks and each have a stub terminal in case the loop is obstructed for any reason, such as in case of fire, which would prevent the trains from making the complete circuit through the downtown district. These diamond crossovers are to be provided in sufficient numbers, there will probably be five of them in all, to admit of running trains from all four of the roads partially round the loop in such a way as to give the use of the maximum amount of the loop tracks for each of the lines using them. The exact locations of these switches have not yet been decided upon, but as far as the arrangement of the crossovers themselves is concerned, the plan is complete. It is the intention to locate these crossovers near stations and they are to be alike as to arrangement of switches and sig-



INTERLOCKED CROSSOVERS—UNION LOOP RAILROAD, CHICAGO.

nals, and further, the locking is to be identical in all of them, so that a man who understands the operation of the levers in one, may operate any of the others.

The crossovers are to be operated in each case by an eight lever machine, all of the levers being active, and as the machines are intended to provide protection only in case of emergencies, it is not the intention to house them in, but merely to protect them sufficiently to protect the locking from being injured by the weather. The plants are signaled for every possible movement and the interlocking apparatus will be put in by the National Switch & Signal Company. No switch and lock movements are to be used. It will be noticed that the tracks on the loop are to be operated left handed and attention is also called to the fact that the signals are located but 30 ft. from the switches which they govern.

In the design it was necessary to provide for two minute intervals between trains which introduced a number of difficult problems in signaling, and in fact the handling of the trains over this loop is likely to be exceedingly interesting because three of the roads cross drawbridges immediately before entering upon the loop tracks which will at times cause bunching of trains from all three of these roads. The junction interlocking plants on this account have been arranged with a view of handling trains with the least loss of time and the system of grouping levers which was designed by Mr. Sperry and applied at the Marshfield avenue junction on the Metropolitan Elevated Railway, and described in the RAILWAY REVIEW of November 30, 1895, has been employed in such a manner as to bring all of the levers which are used in the regular train movements within the smallest possible compass. The levers used for emergency movements are put at the opposite end of the machine and are also grouped. In addition to the signal engineering problems already referred to, Mr. Sperry has prepared an elaborate schedule showing the maximum traffic which can be handled over

the loop tracks upon a basis of a speed of eight miles per hour for all trains. This scheme is a specially interesting one; a novelty as a part of the plan of interlocking signaling, and will probably be presented in a future issue with illustrations.

HISTORICAL DEVELOPMENT OF STONE BRIDGES.*

The first stone bridges were simply blocks of stone laid horizontally over an opening. Such bridges are still used for spanning narrow openings, and in some countries for crossing streams of not inconsiderable width. In buildings, this is still the most common mode of spanning an opening. The next step was to corbel out, letting one stone project beyond the one beneath it, and in this manner span larger openings than would be possible with one stone alone. The next step was to cut off the lower projecting corners of these corbelled stones, making a structure in appearance like an arch—a so-called false arch—though in principle it is not in any sense a true arch. These false arches were used by the Egyptians, the Assyrians, the Greeks, and other older nations.

The principle of the arch appears to have been known to the Assyrians and to almost all of the older nations whose structures have become known to us. All of the Assyrian arches thus far discovered are of brick, the bricks being made of a wedge shape, or thicker at the outside than at the inside. Most of the arches were semi-circular, and the maximum span found is 15 ft. The only pointed arch discovered in the Assyrian ruins is built of brick of the ordinary shape, the joints being thicker on the outside; while instead of the keystone ordinary bricks were laid longitudinally between the two sides. The arch was used by the Assyrians for doors, gates, drains, aqueducts, and chambers or galleries.

Still earlier than the Assyrian arches, which belong to about the Ninth century B. C., were the brick Babylonian arches, as early as 1300 B. C., while in Egypt arches were known as far back as the fifteenth century B. C. The early Egyptians, however, though undoubtedly acquainted with the arch principle, avoided arches and seem not to have fully grasped the idea of using a large number of thin stones laid with the long sides touching. The Hindoos to this day refuse to use arches. They have a saying that "the arch never sleeps" meaning by this that it continually exerts a horizontal thrust upon its supports, tending to disintegrate and destroy them. This quaint saying is

when the springings of the arches were placed at different levels, and higher towards the ends. In general, however, they preferred to place the springing lines of all the arches at the same level, making the roadway inclined from each end towards the center, sometimes with an angle at the center, and sometimes with a horizontal portion above the center span. The contraction of the water way due to the thickness of the piers was in part made up for, in some cases, by openings through the masonry above the piers or in the haunches. But while the excessive thickness of the piers of the Roman bridges had the effect of increasing the danger of undermining, it resulted in the advantage that each pier was able to resist the thrust of the arch on either side of it, even though the arch on the other side should be destroyed. The fall of one arch, therefore, did not result in the fall of the adjacent arches, as would be the case in many modern bridges. The piers were made triangular at each end, or sometimes semi-circular. The bridges carrying roads were provided with continuous solid parapets.

In the arches, as well as in the other masonry structures of the Romans, the stones were laid dry, that is, without beds of mortar. Moreover, each arch was frequently made up of several rings of arch stones not bonded, or connected together in any way. Some of these bridges are still in existence and differ comparatively little from modern structures.

The most important of the Roman bridges, however, were in connection with the aqueducts which supplied the cities with water. There were nine of these aqueducts supplying ancient Rome in the time of Frontinus, "Curator Aquarum" from 97 to 106 A. D. The third, or Martian aqueduct, was built 144 B. C., by Quintus Martius, and was partly above ground, and its remains may still be seen. It had nearly 7000 arches in a course of 39 miles, with spans of 16 ft. It was constructed of different kinds of stone, red, brown and yellow. The arches in many places were more than 70 ft. in height. This aqueduct was built so strong that the two succeeding ones were built on top of it, thus giving three tiers of arches, one above the other. The eighth, or Claudian aqueduct, 45 miles long, and the ninth, 62 miles long, were both begun by Caligula, A. D. 38, and completed by Claudius, A. D. 52. Along the greater part of their course they are carried on the same line of lofty arches with spans of about 20 ft., the highest of all the aqueducts supplying Rome. Magnificent remains of the Claudian aqueduct, built of massive blocks of tufa, still exist for many miles across the Campagna. "A great number of these arches are still in good preservation, with, in places, later arches built under them by Severus in 201, probably to support them after injury by an earthquake."

In addition to the aqueducts, which supplied Rome, the Romans built many other aqueducts, among which may be specially mentioned that at Nismes, in Southern France, and those at Segovia and Tarragona, in Spain. The noted Pont du Gard was built in the aqueduct supplying Nismes, and is one of the earliest aqueducts constructed by the Romans outside of Italy. It is supposed to have been built in the time of Augustus. This aqueduct had three tiers of arches, but only one channel at the top. The length of this bridge at the top of the second tier is 885 ft. and its maximum height over the river Gardon is about 160 ft.

The arches of the two lower tiers are semicircular. The large arch through which the river passes, is 80 ft. 5 in. in span; the three on the right side of this arch are 63 ft., and the smaller ones 51 ft.; the arches of the upper tier are all equal span, 15 ft. 9 in. The thickness from face to face is at the first story 20 ft. 9 in., at the second story 15 ft., at the third 11 ft. 9 in. The depth of the keystone of the large arch is 5 ft. 3 in.; that of the others 5 ft., while those of the upper story are 2 ft. 7 in. The lower arches are formed of four separate rings, the next above of three, and the upper of one. The arches thus consisted of separate narrow arches side by side not bounded or connected together. This structure is constructed of freestone with rubble filling in the piers and spandrels. The stones were laid without cement, and projecting stones were left to support the centers. The dimensions of the channel are 4 ft. wide and 4 ft. 9 in. high. Above the small arches of the upper tier cement was used in the rubble masonry about the channel. This cement has become as hard as the stone itself, forming one impermeable mass, and preventing any filtration. This beautiful structure was partially destroyed at the end, at the beginning of the fifth century, by the barbarians who besieged Nismes. In 1743 it was repaired and the piers prolonged to carry a new bridge. The entire length of the aqueduct of which this bridge forms a part is over 25½ miles. The fall given to the water along the entire length is 0.04 ft. per 100 ft. and is uniform throughout. This great work of engineering will compare favorably with any of modern times. It shows that the Romans understood thoroughly the art of leveling, and much more of the science of hydraulics than we generally credit them with. Considering the state of physical science at that time, the skill and care displayed in this and other similar works is little short of marvelous.

It is evident from these examples that the Romans were masters of the science of engineering so far as concerns the construction of stone bridges and of aqueducts, and history shows that their skill extended to other branches as well.

After the fall of the Western Empire there was little bridge building in Europe until the twelfth century, when the increase of travel, together with the rapid development of cities and trade, rendered imperative better facilities for crossing streams.

Of all these bridges built between the twelfth and sixteenth centuries it may be said that it is remarkable that

*From a paper by Prof. Geo. F. Swain before the Boston Society of Civil Engineers, published in the Journal of the Association of Engineering Societies.

they stood as well as they did. They were cheaply constructed and very narrow, seldom 20 ft. in width, generally not over 13 to 16 ft., and sometimes but 6 or 7 ft.; the piers were very thick, and the spandrels either perforated or filled with earth.

Perhaps to us the most interesting bridge built within this period (12th to 16th century) is the old London bridge over the Thames, built by Peter of Colechurch. This bridge was begun in 1176 and finished in 1209, and was 926 ft. long and 40 ft. wide. It contained a drawbridge and nineteen pointed arches, varying in span from about 9 ft. to 20 ft., with massive piers varying from 25 ft. to 34 ft. wide. The obstruction caused by these huge barriers, and the large number of piers, reduced the entire channel of the river from its normal breadth of 900 ft. to a total waterway of 194 ft., or less than one-quarter. It is said that this obstruction caused a fall of water at the bridge of about five feet. Only eighty years after its completion this bridge was in such bad condition that men were afraid to pass over it, and the houses on top had arches built between them to hold them together. In 1758 the houses were removed and a large arch constructed in place of two smaller ones. In 1788 the Westminster bridge was begun and completed in 1749. This was the second bridge over the river; but it did not relieve the traffic sufficiently, and repairs were made on the London bridge at a cost of £100,000. In 1824 to 1831 the new London bridge was built, consisting of five semi-elliptical arches, with two spans of 130 ft., two of 140 ft., and the central one of 152 ft. 6 in., and a rise of 37 ft. 6 in. This was the largest elliptical arch built up to that time.

The largest stone arch span constructed up to the present day was found in a bridge built in 1377 by Barnabo Visconti, at Trezzo, over the Adda, which was destroyed in a local war in 1416. It was fortified and defended the approaches of the castle of Trezzo. It was a segmental arch, with a span of 237 ft. and a rise of 68 ft.

In the sixteenth and seventeenth centuries, the principal development appears to have been in the increasing use of elliptical, segmental or other flattened curves instead of semi-circular arches, and in the increased care devoted to construction and ornament. Worthy of note, too, is the improvement gradually being made in the foundations of bridges. The structures of earlier date had generally been founded on stone filling, and the piers had been necessarily thick, in order to distribute the load. The later bridges were founded upon pile platforms, or in caissons; while in the bridge over the Maas at Maastricht, begun in 1633 by the Dominican monk Romano, the first dredging machine is said to have been employed.

The old Westminster bridge, at London, completed in 1750, was the first bridge in which caissons were used in founding the piers. A settling of one pier, however, required the taking down and rebuilding of the two adjacent spans. This bridge had 13 semicircular arches with a maximum span of 72 ft. It stood for about a century, till the demands of traffic led to its being replaced by a cast-iron bridge of seven spans, 85 ft. wide.

The old Blackfriars bridge, built by the Scotch engineer, Mylne, from 1760-1769, had nine basket-handle arches, with a maximum span of 100 ft. and a rise of 40 ft. It was 995 ft. long and 45 ft. wide, and was handsomely decorated with double columns over the piers. The bridge cost £152,840. Owing to settling, however, and also, it is said, to the use of poor stone, it was necessary, in 1833, to repair the bridge at a cost of £105,138. Even then it was not satisfactory, and in 1865 it was replaced by a cast-iron arch bridge of five spans, designed by Joseph Cubitt.

The principal progress during the eighteenth century appears to have been in the increased use of elliptical or other flattened arches, the reduction in the ratio of rise to span, the use of segmental arches with cow horns, the gradually increasing length of span, the use of more slender and graceful piers, the reduction in thickness of the arch ring consequent upon a better knowledge of the mechanics of the arch and the increased beauty of proportion and adornment. Progress, too, was made in the methods of foundation, by the use of caissons, dredges, mechanical pile drivers and saws for cutting off piles under water.

In the present century, and especially since the birth of the railroad in 1830, a great many stone bridges have been constructed, but the types have not changed and the development has simply been in the direction just indicated.

In America there are few large stone bridges. This is but natural in a new country. Not strange is it, either, that most of our large stone bridges are on works of water supply rather than railroads. Our country has been built up by the railroads, which have penetrated in advance of civilization into new regions, and have been too poor at the beginning to build such costly structures—unlike the railroads of Europe which were built through already rich and populous districts. Aqueducts, on the other hand, are built to supply already wealthy and populous cities, and the most durable and expensive structures are justified.

Of railroad bridges there are but very few large structures. The earliest was the Thomas viaduct, between Baltimore and Washington, over the Patapsco river, with eight elliptical arches on a curve. The spans are 58 ft., and the height above the river 65 ft.

The next is the Starucca viaduct, on the Erie road, in northern Pennsylvania, with eighteen arches of 50 ft. span, and 110 ft. high.

A third is the Canton viaduct, on the Boston & Providence road.

All of these, however, compared with the structures which have just been described are unimportant works.

Of aqueducts, the first is High bridge, over the Harlem river, in the old New York aqueduct, with seven spans of 50 ft., and eight spans of 80 ft., the height above the water being about 100 ft.

The second is the Cabin John bridge, over the creek of the same name, in the aqueduct supplying Washington. This was built by General Meigs in 1866, and has one segmental span of 220 ft., with a rise of 57 ft. 3 in., being the largest stone arch span in existence, and only exceeded in the world's history in the case of the bridge at Trezzo, already mentioned. This bridge is but 20 ft. wide.

The third is the Echo bridge, on the Sudbury river aqueduct, supplying Boston. This has a span of 127 ft. and a rise of 42 ft.

ECONOMY IN COMPRESSED AIR.*

The economy of installing the proper kind of a compressing plant is well illustrated by the following comparison between air pumps and compressors:

Tests of 8 inch brake pumps have been made in which it was found that for every pound of steam passing through the pumps there was, on the average, about 2.25 cubic feet of free air compressed to 07 lbs pressure. For every 1,000 cu. ft. of air compressed there is, therefore, required 445 lbs. of water, and if the evaporation of the boiler supplying the steam is taken at 8, the coal required is 55.6 lbs. The capacity of one 8 inch pump with 80 lbs. of steam is about 1,000 cu. ft. per hour, and if we assumed that the pump ran the equivalent of 10 hours per day for 300 days in a year, the annual coal consumption is $55.6 \times 10 \times 300$, or 83 tons. As it is seldom that a single pump is of sufficient capacity for a yard or shop, and as even the smallest belt compressors are usually of the capacity of two such pumps, we will first make a comparison on the basis of 2,000 cu. ft. of free compressed per hour, requiring two pumps consuming 166 tons of coal per year. It might here be remarked that as the speed of the pumps varies considerably with slight differences of pressure, it may reasonably be urged that one pump might be made to do this work if higher steam pressure were used; but if this is done, the coal consumption is not altered materially, nearly the same amount of steam passing through one pump instead of two.

In considering compressors of small capacity, those driven by belts must not be overlooked. We find by investigation that in this type about 2.8 horse power is required at the belt for each 1,000 cubic feet of air compressed per hour. If the shop engine consumes $3\frac{1}{2}$ lbs. of coal per horse power per hour, and the loss in transmission by shafting, belts, etc., is 40 per cent, the coal per horse power at the compressor becomes $3.5 \div .6 = 5.8$ lbs., and for compressing 2,000 cubic feet of air it is $2.8 \times 2 \times 5.8 = 32.4$ lbs. For a year of the same number of hours as before, the consumption is $32.4 \times 10 \times 300 = 48\frac{1}{2}$ tons.

In a steam compressor, the horse power per 1,000 cubic ft. of air compressed, including the internal friction of the engine, we will take as 3.2, though it will vary somewhat with the construction of the compressor. In one having only 2,000 cubic feet capacity per hour, a horse power cannot be expected on less than $4\frac{1}{2}$ lbs. of coal with the evaporation we have assumed, and it might easily be more. Taking it at that figure, the annual consumption would be $3.2 \times 2 \times 4.5 \times 10 \times 300 = 43$ tons.

Now, a belt compressor of 2,000 cu. ft. capacity per hour, and provided with an automatic regulator or governor, can be bought for from \$200 to \$250, and a steam compressor of that capacity will cost in the neighborhood of \$350. Two brake pumps, even if they are not new, will represent an investment of from \$100 to \$200, according to their age. The comparison between the two types of compressors and the pumps might be summarized in tabular form thus:

	Value of Investment.	Coal consumed in tons, per annum.	Cost of fuel per annum, at \$1 per ton.	Saving per annum.	Saving capitalized at 6 per cent.
Two second-hand belt compressors.....	\$100	166 tons.	\$166.50
One steam compressor.....	225	48½ tons.	48.50	\$117	\$1,958
One steam compressor..	350	43 tons.	43.00	123	2,050

From the columns showing the annual saving and the same capitalized at 6 per cent, it will be seen that if the air brake pumps were to be had for nothing it would still pay to buy the compressors if they cost less than \$2,000. Perhaps a more striking way to view it is that if a road were offered two pumps and a bonus of \$1,500 with them, their use to be confined to pumping air for shop use, it would be wise to refuse the offer and purchase a compressor at market prices. If only one pump were needed it would still pay to buy a compressor of the size mentioned above, and the saving per year in fuel would still be more than \$50.

We think the above figures are fair and not in the least exaggerated. If any one is disposed to question some of the items, let him consider what the comparison would become according to his own figures if coal were at the same time taken at, say, \$2 per ton, a price which many pay for it.

The figures seem to prove conclusively that though the air brake pump is admirably adapted for the service for which it was designed, and is almost beyond criticism when on the engine, it is in the wrong place when compressing air for shop uses. If managers, purchasing agents and others who wield the blue pencils that occasionally disfigure requisitions, could be made to realize these facts, there would be more compressors purchased; for many officials in the mechanical departments, who know the wastefulness of pumps, cannot induce their managements to purchase compressors.

*From a paper read before the New York Railroad Club, Nov. 19, 1896, by Mr. Curtis W. Shields.

A brief comparison between a compressor with a capacity of about 18,000 cubic feet of free air per hour (a favorite size with some roads), and pumps of the same capacity, made on the same basis as the previous comparisons, but assuming that the compressor can furnish a horse power on four pounds of coal, shows that the annual fuel bill for the compressor would be \$348, and of the pumps \$1,500. This is not an ideal case for we know of one company that had ten air pumps in its shops and now has in their place one large duplex compressor. The latter almost pays for itself in one year with coal at only \$1 a ton.

We can readily deduce that an air compressor which has the steam and air cylinders in line on a single straight rod will apply the power in the most direct manner, and will involve the simplest mechanics in the construction of its parts. It is evident, however, that this straight line, or direct construction, results in an engine which has the greatest power at a time when there is least work to perform. At the beginning of the stroke steam at the boiler pressure is admitted behind the piston; and as the air piston at that time is also at the initial point in the stroke, it has only free air against it. The two pistons move simultaneously. The resistance in the air cylinder rapidly increases as the air is compressed. To get economical results it is, of course, necessary to cut off in the steam cylinder, so that at the end of the stroke, when the steam pressure is low, the air pressure is high, as similarly indicated in the other cylinder. The early direct-acting compressor used steam at full pressure throughout the stroke. The Westinghouse pump applied to locomotives is built on this principle; and those who have observed it work have perhaps noticed that its speed of stroke is not uniform, but that it moves rapidly at the beginning, gradually reducing its speed, and then seems to labor until the direction of the stroke is reversed. This construction is admitted to be wasteful; but in some cases, notably that of the Westinghouse pump, economy in steam consumption is sacrificed to lightness and economy of space.

Many efforts were made to equalize the power and resistance by constructing the air compressor on the crank-shaft principle, putting the cranks at various angles, and by angular positions of steam and air cylinders.

Angular positions of the cylinder involve expensive construction and unsteadiness.

Experience has proved that there is nothing in the apparent difficulty in equalizing the strains in a direct engine. It is simply necessary to add enough weight to the moving parts—that is, to the piston, piston rod, fly-wheel, etc.—to cut off early in the stroke and secure rotative speed with the most economical results and with the cheapest construction. It is obvious that the theoretically perfect air compressor is a direct-acting one with a conical air cylinder, the base of the cone being nearest the steam cylinder. This, from a practical point of view, is impossible.

Mr. E. Hill, in referring to the fallacious tendencies of pneumatic engineers to equalize power and resistance in air compressors, says:

"The ingenuity of mechanics has been taxed and a great variety of devices have been employed. It is usual to build on the pattern of presses which do their work in a few inches of the end of the stroke and employ heavy fly-wheels, extra strong connections and prodigious bed-plates. Counterpoise weights are also attached to such machines; the steam is allowed to follow full stroke, steam cylinders are placed at awkward angles to the air compressing cylinders, and the motion conveyed through yokes, toggles, levers, and many joints and other devices are used, many of which are entire failures, while some are used with questionable engineering skill and very poor results."

Mr. J. H. McConnell, superintendent of motive power of the Union Pacific Railroad, furnishes the following interesting and reliable figures, showing what can be done by the use of compressed air in shops.

The many savings through the use of air in shops of the Union Pacific system aggregate \$10,000 per year in labor alone;

	Saving per day.
Putting wheels in wheel lathe, three lathes in the shop, an average of one change a day; save one man in handling this work	\$1.60
Hoisting steel tired wheels and axles in lathe, average of six changes a day; save one hour in time, 20 cents, and one man less to handle the work, \$1.60	1.80
Hoisting axles into cut-off lathe, an average of ten changes a day; save one hour per day in time	.25
One large boring mill averages two changes a day, \$1.60; saving of time of 30 minutes and the use of one helper, 15 cents	1.85
Handling cylinders in large boring mill and planer; save the labor of one man and one-half hour each change	1.60
Three men working on pistons, etc., in raising them from the floor to the bench, serving three machinists; save one helper a day	.85
Raising chucks, face plates and other heavy work; air hoists in the machine shop save one helper per day	1.50
Lifting driving wheels and other heavy work on the large slotting machine; save the time of one man and 20 minutes	1.50
In applying cylinders on boilers; save one machinist and helper's time of 10 hours	2.40
Facing valves; save helper's time of 4 hours	.60
Pressing on driving wheels and axles, etc.: three less helpers, one hour each	.45
Boring out cylinders; three helpers' time, 4 hours	1.80
Applying driving brakes to old engines, drilling holes, reaming, etc., saving 15 hours of time of machinist and helper	6.70

Pneumatic tin and galvanized iron press, in getting out stock for 20 dozen water buckets; get it out in eight hours, where it previously took 40 hours.

In making brake shoes, stamping a loup to have casting run on; previously one man would do 200 in a day, where

he now does 600. All work on this machine saves in the neighborhood of from 50 to 60 per cent.

Running foundry elevator with the air hoist saves 25 per cent of one man's time.

Save 75 per cent time putting in stay-bolts in a fire-box, by using air motor for tapping out holes and screwing in bolts.

Save in the neighborhood of 50 per cent in using pneumatic hammers for caulking both flues and boilers.

Take engines in and out of roundhouse when necessary to change them; saves the work of six men pinching, possibly 45 minutes, not counting the delay of the men waiting to go back to work on the engine.

Blowing out engines with air; save a cord of wood, besides the inconvenience and delay, as the men cannot work around a hot engine to advantage.

Handle all engines on the transfer table, now run by air, previously run by crank. One man does now what six did before; where six men move a foot in a minute, air motor under like conditions will move 12 ft. As this is moved several times a day this is in itself a great saving.

Pneumatic hoist for unloading scrap at the foundry. The old method took six men 10 hours; under the same conditions with the hoist, two men will do it in four hours.

Unloading a car of wheels it takes six men half an hour; now three will do it in 15 minutes.

Sandpapering off a 50 foot baggage car by hand took in the neighborhood of 60 hours; now it takes 14 hours with the sandpapering machine.

Air jacks for raising and lowering freight cars now take one man 3 minutes, where previously it took two men 10 minutes.

Truck jacks to remove three pairs of wheels take 1½ hours; the old method takes 6 hours.

Cleaning a car by air saves 10 per cent in time.

Air whitewashing machine; where it took ten men 5 days, it now takes four men one day, and a 75 per cent better job.

New applications of compressed air are made daily; two of the most recent being an air motor attached to a differential hoist, and a portable staybolt cutter that can be operated in the hands of one man, thus doing away with the cumbersome affair hung on a post.

NOTICES OF PUBLICATIONS.

The artificial drying of lumber is a subject quite extensively elaborated in a pamphlet that has been published by the Emerson Co., of Baltimore, manufacturers of the Emerson automatic compression dry kiln. This system of drying is very fully described, and the text is illustrated with a large number of engravings of the machinery and appliances and photographic reproductions of pieces of lumber that have been dried by this and by other systems. There are also several pages of letters from well-known wood-working establishments that are using the Emerson kiln. One paragraph in this catalog is particularly worth noting. The Emerson Company says: "In purchasing our compression system of kiln the purchaser takes absolutely no risk whatever. A specific guarantee is given to perform a certain amount of work, and payments are contingent upon its fulfilment." A copy of this catalog will be sent free on application.

LOCOMOTIVE MECHANISM AND ENGINEERING, WITH AN APPENDIX ON THE MODERN ELECTRIC LOCOMOTIVE, by H. C. Reagan, Jr. Second edition. New York: John Wiley & Sons. Cloth, 8vo., pp. 419; illustrated; \$2.

This book is prepared especially for the instruction of locomotive runners, with special reference to the operation and care of locomotives, and a prominent place is given to emergency repairs, which are quite clearly illustrated. About seventy pages are given to the subject of compound locomotives, the various well known types of which are illustrated, and these two subjects together with chapters on valve motion and attachments, such as injectors, lubricators and air brake apparatus, constitute the main portion of the work. An appendix of 100 pages treats of the general subject of electric motors, under the head of the modern electric locomotive. Particulars with reference to the construction of the principal large locomotives are given, including the Heilmann, the Sprague, and the B. & O. R. R. locomotives. In this chapter attention is also given to the regulating devices and the different methods of winding motors. The illustrations in the book are clear, the type is large, and the style of writing is simple and easily understood. It is provided with an index and a table of contents.

A recent pamphlet on British railways states that there are 391 depots and stations within the limits of London.

TECHNICAL MEETINGS.

The annual convention of the American Society of Mechanical Engineers will be held at the house of the society 12 West Thirty-first street, New York City, December 1st to 4th, 1896. Secretary, F. R. Hutton.

The Engineers' Club of Cincinnati has a monthly meeting on the third Thursday in each month, at 7:30 p. m. at the Literary Club, 24 West Fourth street, Cincinnati, O. Address P. O. Box 333.

The Engineers' Club of Minneapolis holds its meetings on the first Thursday in each month, at Public Library building, Minneapolis, Minn.

The Engineers' Club of Philadelphia meets on the first and third Saturdays in each month, at 8 p. m., at the house of the club, 1122 Girard street, Philadelphia, Pa.

The Civil Engineers' Club of Cleveland, meets on the second and fourth Tuesdays in each month, at 8 p. m., at the Case Library building, Cleveland, Ohio.

The Association of Engineers of Virginia, holds its in formal meetings on the third Wednesday of each month from September to May inclusive, at 8 p. m., at 710 Terry building, Roanoke, Va.

The Western Railway Club of Chicago, holds its meeting on the third Tuesday of each month.

The Central Railway Club meets on the second Friday of January, March, May, September and October, at 2 p. m., at the Hotel Iroquois, Buffalo, N. Y.

The Denver Society of Civil Engineers meets on the second and fourth Tuesdays in each month except July, August and December, when they are held on the second Tuesday only, at 36 Jacobson building, Denver, Colo.

The Western Society of Engineers holds its regular meetings for the transaction of business and the reading and discussion of papers on the first Wednesday of each month except January.

The American Society of Civil Engineers holds meetings on the first and third Wednesdays in each month, at 8 p. m., at the House of the Society, 127 East Twenty-third street New York City.

The Association of Civil Engineers of Cornell University meets weekly every Friday, from October to May inclusive, at 2:30 p. m., at Lincoln Hall, New York.

The Boston Society of Civil Engineers, meets monthly on the third Wednesday in each month, at 7:30 p. m., at Wesleyan Hall, 36 Bromfield street, Boston, Mass.

The Canadian Society of Civil Engineers meets every other Thursday at 8 p. m., at 112 Mansfield street, Montreal, P. Q.

The Foundrymen's Association meets monthly on the first Wednesday of each month, at the Manufacturers' Club, Philadelphia, Pa.

The Montana Society of Civil Engineers meets monthly on the third Saturday in each month, at 7:30 p. m., at Helena, Mont.

The New England Railroad Club meets on the second Tuesday of each month, at Wesleyan Hall, Bromfield street, Boston, Mass.

The New York Railroad Club has a monthly meeting on the third Thursday in each month, at 8 p. m., at 12 West thirty-first street, New York City.

The Northwestern Track and Bridge Association meets on the Friday following the second Wednesday of March, June, September and December, at 2:30 p. m., at the St. Paul Union Station, St. Paul, Minn.

North-West Railway Club meets alternately at the West Hotel, Minneapolis, and the Ryan House, St. Paul, on the second Tuesday of each month.

The Engineering Association of the South meets on the second Thursday of each month at 8 p. m., at the Cumber and Publishing House, Nashville, Tenn.

The Railway Signaling Club holds its meetings in Chicago, Ill., on the second Tuesday of January, March, May, September and November. G. M. Basford, secretary, 818 The Rookery.

The Southern & Southwestern Railway Club holds its meetings on the third Thursday of January, April, August and November, at the Kimball House, Atlanta, Ga.

The Western Foundrymen's Association holds its meetings on the third Wednesday in each month, at the Great Northern Hotel, Chicago, Ill.; secretary, A. Sorge, Jr., 1533 Marquette building.

The resignation of Mr. B. W. Appleton as general freight and passenger agent of the Unadilla Valley road has been announced.

Mr. J. Stanley Orr has accepted the position of traveling passenger agent of the Southern Pacific at Cincinnati to succeed Mr. C. C. Henion.

PERSONAL.

Mr. W. J. Everson, cashier and paymaster on the Ohio Southern, has resigned, and will go to Knoxville, Tenn., to engage in commercial pursuits.

Mr. D. N. Bell, chief clerk in the advertising department of the Pennsylvania, on December 1 goes to Boston as chief of the New England tourist department.

Mr. Walter Ross has received the appointment of general agent for the Indiana, Illinois & Iowa road, with headquarters at Streator, Ill.

The conductors of the Pennsylvania railroad have a new organization called the "Knights of the Punch" and Mr. Wm. B. Chislett has been appointed president.

Mr. H. H. Purcell has been appointed contracting freight agent of the Wabash Railroad, with office in Chicago; Mr. T. P. Scott has been appointed traveling freight agent in place of Mr. Purcell, also with office in Chicago.

Mr. J. M. Duncan has been appointed general southern freight agent of the Cleveland, Cincinnati, Chicago & St. Louis with headquarters at Chattanooga, to succeed Mr. S. D. McLeish, transferred.

Mr. G. W. Martin, formerly with the Santa Fe, has been appointed general agent of the St. Louis & San Francisco for Colorado, Utah, Arizona, New Mexico, Idaho, Nevada and Wyoming, with headquarters at Denver.

Mr. Chauncey C. Bruman, who for more than 30 years was an engineer on the Erie road, died this week after an illness of several months. Mr. Bruman entered the service of the Erie when a boy, and was looked upon as one of the best engineers in the employ of that corporation.

Mr. Alfred E. King has been appointed chief claim clerk of the St. Paul & Duluth, succeeding Mr. Thos. Stoddard, whose death was mentioned last week. Mr. King has been with the St. Paul & Duluth since he began to work.

It is stated that on December 1, Mr. E. M. Neel, superintendent of the St. Louis division of the Big Four, will be succeeded by Mr. W. G. Bayley, now superintendent of the Cairo division of the Big Four. Mr. Neel and Mr. Bayley are this week inspecting the St. Louis division, on which Mr. Neel has been in service 25 years.

The resignation of Mr. Leander J. Buckley as purchasing agent of the Baltimore & Ohio Railroad has been tendered and accepted. He will be succeeded by Mr. E. H. Bankard, formerly chief clerk to Receiver Murray. Mr. J. K. Andrews, confidential clerk to Mr. Murray, will assume the duties of chief clerk.

Mr. W. H. Young, who for five years has been soliciting agent for the Columbus, Hocking Valley & Toledo in Toledo, has been appointed traveling agent of the Lehigh Valley & Wabash fast freight line. The location of his headquarters is not yet fully determined, but will probably be at Lafayette or Ft. Wayne, Ind., as his territory is Indiana and Western Ohio.

It is stated that on January 1 of next year Mr. Cornelius Vanderbilt will, owing to poor health, retire from active business, and his place will be filled by Mr. W. K. Vanderbilt. It is thought he will make a very successful head of the Vanderbilt properties, as it was his policy which built up the Lake Shore, and his plans with respect to other properties have generally been good ones.

Mr. C. W. Pitts, for many years city passenger agent of the Great Northern, at Helena, Mont., has been appointed traveling passenger agent with headquarters in Chicago. The vacancy at Helena will not be filled. Mr. Pitts succeeds in Chicago Mr. Bryant, who has been transferred to the Chicago office, has been transferred to the Chicago office, the official in charge requiring to go south for his health.

Mr. George W. Ferris, who conceived and built the world-famous Ferris wheel, died at the Mercy Hospital in Pittsburgh, Pa., Nov. 22, of typhoid fever. His illness has been brief, and it was only Friday that he was taken to the hospital. The attending physicians say his system was greatly run down by overwork. George W. Ferris was born at Galesburg, Ill., Feb. 14, 1859. When he was very young the family removed to Carson City, Nev., and it was there he spent the years of his early boyhood. In 1873 he came east and began a course at the Rensselaer Polytechnic Institute of New York in that year. In 1881 he was graduated with high honors. It was in 1892 that Mr. Ferris conceived the idea of the wonderful Ferris wheel, that has attracted the attention of all the people of the world and which will go down in history as one of the greatest wonders of the century. The monster passenger wheel conceived by Mr. Ferris was built under his personal supervision.

RAILWAY NEWS.

Cincinnati, Hamilton & Dayton.—The Cincinnati, Hamilton & Dayton road has made a new departure and has purchased the lines of the street railway company at Middletown, O. The street car tracks will be connected with the tracks of the steam railway and through cars will be opened from all parts of Middletown to Hamilton with electricity, a distance of 15 miles. The most modern equipments will be adopted.

Cleveland, Canton & Southern.—It is expected that in a short time a plan for the reorganization of the Cleveland, Canton & Southern will be proposed, and when the reorganization is effected several extensive improvements will be undertaken. The road has a total mileage of 209½ miles, the main line running between Cleveland and Zanesville being 144 miles in length. In September, 1893 it was placed in the hands of Messrs. J. W. Wardwell and Frederick Swift as receivers, but in July of 1894 the latter resigned and Mr. Wardwell is now sole receiver. In January, 1894, receivers' certificates to the amount of \$124,000 were issued. A committee representing respectively the first mortgage bondholders, the equipment trust and improvement, and the consolidated mortgage bondholders, have been appointed pending reorganization.

Cleveland, Lorain & Wheeling.—The heavy work on the repairs of the tunnel at Fairmont, Ohio, which the Cleveland, Lorain & Wheeling has been prosecuting for the past four months, are now practically completed, and the tunnel is said to be in better condition than ever before. These repairs have cost the company about \$15,000.

Denison & Northern.—The affairs of the Denison & Northern R., which have been in such a complicated condition, are said to be slowly straightening out. The stock of this railway company is now owned by the Missouri National bank of Kansas City, which also controls the mineral leases that constitute the assets of the Hickory Hill Coal & Coke Co., and comprise all of the unappropriated coal measures in the neighborhood of Lehigh and Coalgate, as well as other valuable mineral deposits. The matter was before the master in chancery, Judge Kilgore's court at Ardmore last week, upon an application of the stockholders to vacate the decree, appointing a receiver of the railway company's property for want of jurisdiction, and the findings of the master will be reported to the court on November 30. The stockholders were represented and the hearing was attended by representatives of all the local creditors, and by Mr. Judson Hoke, who is largely interested in the coal properties to be developed by the projected road. The ground of the stockholders' plea to the

jurisdiction is want of authority in Mr. O. H. Brown, who entered an appearance to the action in which a receiver was appointed as president of the corporation, and the plea is met by the claim that Brown was served with process as acting president and that his voluntary appearance was subsequent to this service, and also that he had been elected president of the corporation under the laws of Texas, and that his authority had never been rescinded.

Forest City & Sioux City.—By order of the United States district court, the Forest City & Sioux City road has been sold at public auction. The purchaser is the New York Security & Trust Co., owner of the mortgages under which foreclosure was made. The road was bid in for \$50,000, and the other property for \$2,500. This line extends from Gettysburg in Potter county to Forest City, a distance of nearly 17 miles. In November, 1895, it went into the hands of a receiver, since which time it has not been operated. Several Chicago and New York parties also had an interest in the old road.

Gulf & Interstate.—The Gulf & Interstate road made an application for an injunction restraining O'Connor & Smoot, jetty contractors, from interfering with and obstructing the company's train at Bolivar Point. The injunction was granted and the company now sues for \$10,000 for tearing up its track.

Little Schuylkill.—It seems probable that after the 30th of November the Little Schuylkill will cease to be a part of the Philadelphia & Reading system, to which it was leased in 1868 for a term of 93 years. Notice was given several weeks ago to the officers of the Catawissa R. the Mine Hill & Schuylkill Haven R. and the Chestnut Hill R. that the present leases of these roads would be terminated on the 30th of November. The purchasers of the franchises and property of the Philadelphia & Reading R. Co.—Messrs. Coster and Stetson—electing not to take them, as they were authorized to do by the decree of the United States circuit court confirming the sale. The officers of all these roads, excepting the Little Schuylkill R., after due consideration, have expressed their willingness to have the new corporation—Philadelphia & Reading R. Co.—continue to operate their roads under the modifications and reduction of rentals proposed by the purchasers. In the case of the Little Schuylkill R. it seems at present probable that the officers of that road will not recommend to their stockholders a reduction of the rental, and preparations have therefore been made by the Reading company to conduct their passenger, freight and coal business without using the lines of the Little Schuylkill R., or those of the East Mahanoy R., which are included in the same lease. What arrangement, if any, have been made by the Little Schuylkill R. to operate the road after it shall have been surrendered on the 30th instant have not yet been stated. The line runs from Port Clinton to Tamanend, Pa., and has a trackage of 54.8 miles.

Montana Railroad.—The last spike on the Montana R. was driven at Leadboro on Thursday of last week. This road is about 60 miles long and runs from Leadboro, a sign-post two miles from Castle, to the Northern Pacific road, near Townsend. The first regular train run over the road was an ore train carrying 300 tons of ore to the East Helena smelters. The district is now busy and there is much activity in the mines which seems to promise that the road will have a heavy traffic. Of late there has been some delay owing to the building of the 600 foot bridge just west of Leadboro. Mr. R. A. Harlow is president, and Mr. A. G. Lombard, chief engineer of the new road.

Natchez, Red River & Texas.—It is said that the construction of this line into Shreveport, La., will begin some time this winter. This company was chartered in 1881 to build a line from Vidalia to the Sabin river, a distance of 160 miles. The company bought the old Vidalia & Western R., extending between Vidalia and Concordia, paying therefor the sum of \$60,000. The line was then rebuilt with new material during the year 1883, and in 1886, after being extended to Black river, was opened for traffic. Should this line be finished as projected it will be an important link between the west and the Mississippi valley, as it will connect at Shreveport with the Texas & Pacific, the Kansas City, Watkins & Gulf, the Queen & Crescent and the Gould system. With these connections in the west and the Yazoo & Mississippi Valley and the New Orleans & Northwestern at the eastern terminal, the importance of the project is readily to be seen.

Pittsburgh, Shenango & Lake Erie—Butler & Pittsburgh.—According to press reports, all arrangements are completed for merging the Pittsburgh Shenango & Lake Erie road with the new Butler & Pittsburgh and the lines of the Carnegie Steel Co. Parties interested, of which Col. S. B. Dick, president of the P. S. & L. E. is one, were in New York during the past week, conferring with Mr. Carnegie, and it is understood that the final papers will be drawn within 90 days, and that twenty millions of dollars will be invested in completing and improving the consolidated properties.

Strasburg & Harrisonburg.—This road, which is 49 miles long, was leased in 1873 to the Baltimore & Ohio for 99 years by what was then the Washington City, Virginia Midland & Great Southern R., now a part of the Southern. On November 20 an order signed by Judge Morris authorizing the receivers of the Baltimore & Ohio to deliver up to the Southern R. possession of the Strasburg & Harrisonburg branch. Proceedings were recently instituted by the Southern Railway to recover the rental of \$89,250 due from the year ended September 1. In their answer to the suit the receivers recommended that the branch be surrendered to the Southern Railway, as it was not to the interest of the Baltimore & Ohio to continue the lease. The order requires the branch to be surrendered to the Southern Railway at midnight on November 30, 1896, but without prejudice to the Southern's claims for rentals due.

The receivers are also to pay to the Southern \$6,607 net earnings of the branch for the six months ended August 31, 1896, and also the net earnings up to the time of the surrender.

Terre Haute & Indianapolis.—In the United States district court at Indianapolis on Nov. 13, appointed a receiver for the Terre Haute & Indianapolis R. Co., familiarly known as the Vandalia Line, naming Volney T. Mallott, president of the Indiana National Bank, as receiver for the Terre Haute & Indianapolis, Terre Haute & Peoria, Indiana & Lake Michigan, Terre Haute & Logansport, and St. Louis, Vandalia & Terre Haute lines, under a bond of \$50,000. The receivership was the result of the suit of Mark T. Cox, James A. Blair and James W. Paul, Jr., against the company, and the ground for the receivership was the admission of the company in court that it is insolvent. The Vandalia has been known as one of the most prosperous railroads in the country, and until a year ago, when it passed into the control of the Pennsylvania Co., which purchased a majority of the stock, it met its dividends and all charges with the utmost promptness. The appointment was the result of troubles growing out of the company's contract with the St. Louis, Vandalia & Terre Haute R. and the non-payment of interest on bonds connected therewith. Vice President and General Manager Turner is reported as saying: "There will be no change, either in the policy or the office forces of the system. The receiver will continue the operation of the various lines without perceptible change."

Wisconsin Central.—The issue of receivers' certificates which Judge Jenkins permitted the Wisconsin Central to make in November of 1894, has been extended for another year. This issue which was for \$2,000,000 was due last Sunday and holders of certificates who are unwilling to extend the time of payment will have the amount of their holdings paid on presentation to Maitland, Coppel & Co., Edward Sweet & Co., or Brown Bros. & Co., New York, who placed the original issue and have agreed to handle the extension.

Yankton & Norfolk.—Reports state that actual work has begun on the new Yankton & Norfolk which is to be built from Yankton, N. D., to Norfolk, Neb. Ex-Chief Engineer Miller of the Great Northern has charge of operations, and expects, so it is said, to have the line completed next spring. Just what, if any, relation the new road bears to the Great Northern is not known, but in spite of all reports to the contrary, it is thought, when completed, the new road will be an adjunct to the Great Northern. It is also said that next year the Great Northern will invade both Northwestern and Burlington territory by building across the reservation from Yankton, or a point north of it on the Missouri river to the Black Hills.

NEW ROADS AND PROJECTS.

Canada.—It is stated that the old Baie des Chaleurs road running from Metapedia to Caplin, a distance of 80 miles, is about to be purchased by the Dominion government and incorporated into the Intercolonial system. This road was first projected to Gaspe—180 miles—in 1882 but only the present mileage was completed. In 1894 the road was purchased by the Atlantic & Lake Superior Co., and the remainder of the line is being constructed under that company's charter. Should the government obtain control it is expected running powers will be rented the Atlantic & Lake Superior on condition that it completes the line from Point Levis to Longueuil, opposite Montreal.

It has been given out that President Winter of the Northern Pacific has made the statement that the new company did not intend to resume the contract made by the old company to construct a line from Vancouver to Sumas and connect with the Northern Pacific.

Florida.—The work of construction on the Florida Western is now under way. Mr. R. L. Bennett, chief engineer of the road is quoted as saying that he has 150 men at work, some grading and others cutting out the right of way. More than a mile of the roadbed is graded, and five miles of the right of way cleared out. The line from Apalachicola to Carrabelle will be twenty-two miles in length, with four miles of trestling and two drawbridges. Land has been secured from which will be cut the cross-ties, timber for bridges, trestles, etc., and contractors are figuring on plans and estimates for the bridges and trestling. The contracts for the cross-ties and trestling will be given out the first of December. He hopes to have the roadbed ready for the rails by March or April. He also says that he is not building a railroad to interfere with any other line, but desires the most cordial relations with all railroad companies. Eventually the line will be extended northward. Less than 200 miles would close up all of the gaps between Tallahassee and Augusta, Ga., and form a direct line north and east from this part of Florida which would stimulate the growing of vegetables and fruits in Middle Florida for northern markets.

Indiana.—It is expected now that the Benton Harbor & Southeastern, which is now under construction, will be ready for service by March next. The present line will run between Benton Harbor, Mich., and Nappanee, Ind., and as soon as the Cincinnati, Union City & Huntington R. is built to Huntington it is intended that a line will be constructed from that place to Nappanee, a distance of 35 miles, via Warsaw and South Whitley, and the two roads will be consolidated. The promoters of the enterprise state that these roads are not being built merely on paper, but they will soon be a reality. This statement is corroborated by the fact that the work of construction is being vigorously pushed on both lines. It is believed that the Baltimore & Ohio is behind the scheme, in order to get a line between Cincinnati & Chicago.

Michigan.—The people of Au Gres are negotiating with the Detroit & Mackinac Railroad to build a branch to that place and thence to Point Lookout—a distance of 13 to 15 miles. The Point is quite a summer resort and is patronized largely by Detroit, Saginaw and Bay City people. The right of way has been acquired a portion of the distance, and a bonus has been subscribed by Au Gres people. The company is now considering the advisability of this branch.

Missouri.—A contract has been made between the railroad committee of El Dorado Springs, Mo., and the Midland Construction Co. of Des Moines, Iowa, for the construction and equipment of a standard gage steam railroad from El Dorado Springs to Walker, Mo., a station on the Missouri, Kansas & Texas Ry. The work is to begin at once. El Dorado Springs is a sanitary resort about 95 miles south west of Kansas City and 22 miles due east of Nevada, Mo. Its average population in the season is 3,000. It has six hotels, two flour mills, wagon works and other minor manufacturing industries, and the acquisition of a railroad will doubtless add greatly to its property and ground.

It is said also that eastern capitalists are looking over the route from Rich Hill to El Dorado Springs, Mo., with a view to building the long talked of Rich Hill & El Dorado road.

The construction of the 34 miles of railroad necessary to the consolidation of the Quincy, Omaha & Kansas City road and the Omaha & St. Louis road, it is said, will be built at once. The line has already been surveyed and now that legal preliminaries are completed, as soon as the bids can be advertised for and contracts let, actual work may begin. It is said the syndicate has plenty of money to cover all requirements.

New Jersey.—A branch line connecting Newton, N. J., with the main line of the New York, Susquehanna & Western has been surveyed. The line will be only about three miles in length, and it is understood that the right of way is all the road asks. Newton now reaches New York via the Sussex road and Delaware, Lackawanna & Western.

Oklahoma.—A corps of engineers has just finished a preliminary survey of a line from Shawnee north through Chandler in Lincoln county, to Cushing in Payne county. This branch will be built in the interests of the Choctaw, Oklahoma & Gulf and will secure to that road the entire trade of eastern Oklahoma and the western Creek country. Mr. J. F. Holden of South McAlester is general manager and he together with other officers has visited Lincoln county and will report to the directors at an early meeting, recommending the building at once of the branch.

INDUSTRIAL NOTES.

Cars and Locomotives.

—The Bloomsburg Car Mfg. Co., Bloomsburg, Pa., are now filling orders for box and flat cars for South America, box cars for Mexico, and a number for Jamaica, with other export orders in sight. They report business improving.

—The Pittsburgh Locomotive Works, on Nov. 16, delivered to the B. & O. R. R. engine No. 1624.

—The Indiana Car Works, of Indianapolis, have an order for 50 stock cars for the Mather Stock Car Co., of Chicago.

—The Illinois Central Railroad Co. has placed its orders for the 1,000 box cars mentioned last week. The Pullman Co. has the contract for 500 and the Wells & French Co. for the other 500.

—It is currently stated that the Missouri Car & Foundry Co. has contracted to build 10 furniture cars for the Kansas City, Pittsburg & Gulf Ry.

Bridges.

—It is stated that the plans submitted by the Chesapeake & Ohio R. Co.'s engineers for the proposed railway bridge over the Ohio river at Ashland, Ky., have been adversely reported by the United States engineers, and new plans with a larger channel span as recommended by the Pittsburgh rivermen will be prepared at once. With this change the engineers will doubtless accept them without objections.

—Marion county, Ga., has accepted plans of the King Bridge Co., of Cleveland, Ohio, for a proposed steel bridge to cost about \$20,000. Bids will be opened December 7.

—The citizens of Lyme have petitioned the secretary of war for an order compelling the New York Central Railroad Co. to construct a draw in its bridge across Chaumont Creek, so that the stream will be navigable to Depauville.

—An ordinance has been introduced in the Chicago (Ill.) council authorizing the construction of a bridge over the Chicago river at North Carpenter street.

—Bonds have been issued by the city of Green Bay for the purpose of building a new bridge on Main street. The city clerk will receive bids for constructing the bridge.

—Bids are asked until December 2 for constructing the superstructure and postbents of the Chicago street viaduct, Buffalo, New York, between north line of Carroll street and south abutment of the Hamburg Canal, also the approach in Exchange street connecting with the viaduct; prices required for each span and approach separately and for sum total.

—It is stated that the Electric Railway Co. will have to build a new bridge at Bolym Brook, near Warehouse Point, Conn., and have bought land for the purpose.

—Information has been received that the Western Maryland R. Co. has decided to bridge the Susquehanna River at Chickies, two miles west of Columbia, connecting with

Reading & Columbia branch of the Philadelphia & Reading Railroad at Columbia, the terminus of the branch line.

—An ordinance has been introduced in the common council of Scranton, Pa., calling for the issue of \$150,000 bonds for building a viaduct on West Lackawanna avenue. At the spring election of 1895 the people voted down a similar measure.

—There is a probability of an agreement between the city and the Erie Railway relative to a bridge over the tracks in Cleveland, O., between Praha and Martin streets, by which work can soon be commenced.

—The city of New Haven, Conn., has been ordered to build at once the proposed bridge at East Chapel street over the tracks of the New York, New Haven & Hartford Railroad. The order for the building of the bridge, which now stands with slight modification, was passed by the railroad commissioners in June, 1886, and approved by the superior court in July of the same year. It provides that the city shall build the bridge, the embankments and abutments. The bridge is to be 15 ft. above the tracks, which the railway company must lower 20 ins. The damage assessed to property owners will be paid by the city and the railway, jointly.

—Contracts have been awarded to the Pennsylvania Steel Co. for new iron bridges at the following points on the Central Railroad, of New Jersey: Overhead highway bridge at Tyrrell road, near Fawnwood, N. J.; over Rockaway river, at Dover, N. J.; over highway, near Lebanon, N. J.; over Polhemus creek, near Bound Brook. They will cost \$10,000 each.

—The Cincinnati Southern Railroad is rebuilding two of the land spans of its great bridge, at Cincinnati. They will be 190 ft. each, through truss spans made of steel, and will carry the heaviest engines and loads that may be put upon them. With the completion of these last two shore spans the Southern bridge will stand as one of the most substantial structures in the world. The channel span, which is 520 ft., was the largest and longest span in existence at the time it was built. The Detroit Bridge Company is doing the work through the Southern's chief engineer, G. B. Nicholson.

—It is stated that estimates are being made for a bridge across the Ohio river at Marietta, O., the original survey of which was made three years ago. The bridge will cost about \$3,000,000, and will be for railway, vehicle and foot travel.

—Work has been begun on the Sinking creek bridge, a large iron and steel structure across Sinking creek, ten miles from Florence, Ala. The Converse Bridge Company of Chattanooga, has the contract.

—It is reported that at a meeting of the Montreal board of trade held Nov. 10, it was resolved to petition the council to ask parliament to authorize the city to issue bonds not to exceed \$1,000,000 as a subsidy for the Quebec Bridge Co.

—Press reports state that a proposition was submitted to the board of supervisors by the Citizen's Improvement Co. of Oregon, Ill., to build a \$20,000 iron bridge.

—Press reports state that work will be begun on the proposed bridge between Ottawa, Ont., and Hull at once, as at least \$50,000 worth of work must be done before Jan. 1.

Buildings.

—The new Butler & Pittsburgh Railway has purchased a tract of 123 acres of land near Hutton Station on the Allegheny Valley R. A portion of the property, it is said, be used as a site for car shops. The price paid is given at \$73,000.

—The Chester & Lenoir Railroad Co. will build shops at Lenoir, N. C.

—The East Birmingham (Ala.) Foundry & Machine Co. is preparing to increase its capacity in all departments, and will make important additions to its plant, particularly in the Corliss engine department. A specialty will be made of building Corliss engines.

—It is stated that the announcement was made November 11 that a contract has been closed between the Des Moines Union Railroad and the Chicago, Great Western & Wabash, Chicago & Northwestern, Des Moines Northern and Chicago, Milwaukee & St. Paul roads by which the local company is to build a \$200,000 union station in Des Moines, Ia., on Cherry street, between Fifth and Seventh streets, next spring. The Des Moines Union will also build extensive shops and the Great Western will build a big freight depot, to cost \$50,000.

—The machine shops of the Florida Southern Railroad, which have been at Palatka, Fla., for many years, are being moved to High Springs. Several mechanics have been taken away, and cars this week are being loaded with the contents of the storeroom. The machinery will in a few days be out, but the paint shop and foundry will probably not be cleared for some time.

—Andrew Carnegie has just opened bids for the new public library which he will erect for the town of Homestead. The estimated cost is \$250,000. Similar buildings are promised to the towns of Duquesne and Carnegie.

—It is reported that the New York Central & Hudson River Railroad Co. is to spend \$50,000 in improving its passenger station at Buffalo, N. Y.

—The preliminary work for the Georgia Car & Manufacturing Co.'s buildings at the junction of the Charleston & Savannah and Florida Central & Peninsular Railroads is progressing. The brick foundations for some of the buildings have been put down and some of the beams have been put in place.

—The Salem Iron Co. of Leetonia, O., will erect a casting house, and has given the contract to the Shiffler Bridge Co., Pittsburgh. The Shiffler Bridge Co. is now making additions to buildings for the Riverside Iron Works and A. M. Byers & Co. It has also contracts for two furnaces for the Salt Manufacturing Co., Natrona, Pa., a stock house for the Low Moor Iron Co., an 11-stall roundhouse for the Cornwall & Lebanon Railway, a locomotive coaling station for the Philadelphia subway, and two large buildings for the Gas Engine & Power Co., New York.

—James Stewart & Co., has recently taken the contract for the erection of the St. Joseph county court house, South Bend, Ind. The general dimensions are to be 120x180 ft., and the total cost \$275,000. The building is to contain two very large and elaborate court rooms. The marble and ornamental iron work are two of the principal items of cost.

Iron and Steel.

—The Boies Steel Wheel Co., of Scranton, Pa., has made a remarkable record during the dull times of the last two years, and is to be congratulated. Their works have been run on full time for over two years, and for much of that time 15 hours a day. The past season, even a summer vacation shut down could not be had, there was so much business offering. This steady demand for the Boies wheel is a strong recommendation.

—The plan for the long talked of station for the Pittsburgh & Lake Erie, at Pittsburgh, has been prepared, and will be submitted to the board of directors at their next meeting. It is expected that the plans will then be approved and that work will be commenced early next spring.

—It is rumored that the Texas & Pacific Railroad Co. will erect another grain elevator at Westwego.

—The Daily Press says that the Standard Oil Co. will soon commence the work of doubling the refining capacity of its plant at Constable Point, N. J., and will spend \$1,700,000 in the park.

—The General Electric Co. is building an addition to its plant at Schenectady, N. Y., and has given the contract for the steel structural work to the Pittsburgh Bridge Co. The building will be 100 x 236. The contract for the new Monongahela Connecting Bridge has also been given the Pittsburgh Bridge Co. and work upon it will begin at once.

—A press report says that the Des Moines Union Railway will build extensive shops, and the Great Western Railway will build a large freight depot, to cost \$50,000.

—The Southern Pacific Railroad Co. will build a depot in Cuero.

—The Union Bridge Co. employees completed the erection of the Red Jacket shaft rock house for the Calumet & Hecla Mining Co. This is the largest structural steel mining shaft house in the world, placing over two million and a quarter feet of steel on a space 41 x 80 ft. Over 45,000 ft. were used. It was built in fifty days.

—The Eagle Furnace at Spring Valley, Wis., will be sold at auction in Ellsworth, Pierce county, Wis., on Dec. 10. The furnace is 65x13 feet, designed for charcoal fuel. The property consists of 74 acres on which are tenement houses and office buildings. Raw materials may be had at convenient distances. The iron from this furnace has been successfully used for car wheel and malleable purposes. D. B. Dewey, 111 Monroe street, Chicago, is receiver and master commissioner.

—The Gate City Rolling Mill at Birmingham, Ala., has resumed operations, employing 500 men.

—Bids are asked until Dec. 1 for the iron work for lock gates on the Great Kanawha river, at Charleston, W. Va.

—The machinery of the great plant of the Ironton Structural Steel Co. of Duluth, was turned for the first time on the 9th inst. The results were very satisfactory to the officials. The company will employ 100 men from the start and will increase the number as business demands.

—A contract has been made with Carnegie & Co. for 7,000 tons of steel rails, 75 lbs. to the yard, for immediate delivery to the Baltimore & Ohio Southwestern Railway. The rails will cost somewhere in the neighborhood of \$200,000 and will be delivered by about Dec. 1.

—One of the finest castings ever turned out by the Penn Steel Casting Co. of Chester, Pa., is the stern post for the battleship Kearsarge now being built at Newport News. When ready for shipment the stern post will weigh about 70,000 lbs. Two 25 ton furnaces were used.

—It is said that the Bass Car Works at Lenoir City, Tenn., will at once resume operations.

—Indianapolis expects to secure a rolling mill for the manufacture of bar and sheet iron, projected by a number of capitalists, among whom are Henry Groombacher of Cleveland, Ohio, and Frank Holder of Lansing, Mich. Puddling furnaces are to be used which have been invented by Henry B. Hall of Ligonier, Pa., who claims that they will save two-fifths of the ordinary labor and fuel.

—The Tennessee Coal, Iron & Railroad Co. recently made another shipment of 10,000 tons of pig iron to England, making a total export of 40,000 tons in the past three months.

—The Illinois Steel Co. has ordered 30,000 tons of manganese ore from mines at Leadville, Colo., to be shipped to Chicago and Joliet as fast as the mineral can be mined. This is said to be the first of a series of large orders consequent on the recent visit of Prest. Gates to Colorado and the result of experiments with the local product, which is claimed to be preferable to that of foreign countries. The

amount of money involved in the deal is from \$600,000 to \$1,000,000.

—The Cleveland Steel Co. will, in addition to its present output, soon begin the manufacture of open hearth and crucible steel. On Monday last the capital stock of the concern was increased from \$300,000 to \$500,000. Vice President John A. Potter states the extra capital will be used for buildings and furnaces for the new project, which are at present under the course of erection. Everything will be completed by Jan. 1, and it is expected that work will be started at that time. The building which is now going up will be 60x125 feet, and other additions will be made as soon as practicable.

Machinery and Tools.

—The Newton Machine Tool Works, of Philadelphia, has an order from the Central Railroad Company of South America for heavy milling machine equipment, including the heaviest class of rod milling machines, heavy plain milling machines, vertical rotary planers, etc.

—The Vulcan Iron Works, whose new office is located at No. 59 Milwaukee avenue, have just booked an order for a large steam dredge for the Illinois Terra Cotta Lumber Company of Pullman, also new cast steel tracks, racks and pinions for the Wells streets bridge and cast steel brackets for the Lake street bridge. They are figuring on a large quantity of other heavy work.

—The Pawtucket Manufacturing Company of Pawtucket, R. I., makers of bolt and nut machinery, made a shipment of seven heavy machines to Glasgow, Scotland, and 15 machines to Russia last summer. They have sent 40 machines to England, and are now packing machinery for that destination, and have marketed machinery also in Holland and Germany.

—The Q & C Company, manufacturers of metal sawing machinery, railway supplies, etc., whose offices are in the Western Union Building and works at Chicago Heights, report large orders for rail joints and a more active demand for their machinery specialties. They are working on several new devices which will soon be placed on the market. During the last ten days they have added about 30 men to their force at the factory.

Miscellaneous.

—We are advised that Mr. Charles Hansel, civil engineer vice president and general manager of this company, will sail December 2, on the City of Paris en route to Russia by invitation, for the purpose of making a report on a suitable system of block signaling and interlocking for the Russia Railways.

—Preparations are being made by the promoters of the Massachusetts Maritime Canal Co. to deposit \$200,000 with the state treasurer to secure the right to construct the Cape Cod Canal. Press reports announce that the preliminary plans have been prepared and approved by the joint boards of railway and harbor and land commissioners, and the locations and other specifications for presentation to the Barnstable county commissioners as soon as the deposit has been made with the state treasurer. The canal is to begin at some point in Buzzard's Bay, running through the towns of Bourne and Sandwich, or either of them, to some convenient point in Cape Cod or Barnstable Bay. It is to have a depth of not less than 25 ft. at mean high water, at a width of not less than 100 ft. at the bottom, with suitable slopes, and with a surface width of not less than 220 ft.

—A new Pintsch gas plant is being erected at Pittsburgh for the benefit of the Baltimore & Ohio Railroad, which has adopted this light for its passenger trains.

—Bids are asked until December 19 for hire of dredging plant to be operated on dredged channel of Mobile river and Mobile bay.

—Bids are asked until December 11 for constructing dikes and bank protection in the Ohio river at and near Evansville, Ind.

—The Chicago Acetylene Gas & Carbide Company, recently incorporated under the Illinois statute, is said to have purchased the Mayo patent for making calcic carbide. The company is erecting a plant at Oregon, Ill., where it claims 6,000 horse power. Capacity of plant, six tons per day. It is to be in operation in thirty days. Under the Mayo plan powdered lime and coke dust, after being placed in a stationary furnace, are submitted to a heat of 2,000 degrees, generated by an oil process. This reduces the component parts to a molten mass, which drains through between two stationary horizontal electrode points, giving forth an intermittent electrical current of great heat. It is claimed for this method that there can be no breaks in the electrical current from the fact that the electrical heat is not applied until the ingredients have a uniform temperature, which produces a uniform and almost pure crystallized calcic carbide without slag. Officials of the company say they are willing to take orders for carbide at \$35 per ton.

—The Falls Hollow Staybolt Co., of Cuyahoga Falls, O., has from time to time received some very complimentary letters from the officers of railways on which its hollow staybolt is in use, and the following is a very fair sample of their character:

Falls Hollow Staybolt Co., Cuyahoga Falls, O.

GENTLEMEN:—Specifications of standard Wabash engines have been recently issued, and the proposition is to be in the market for a number of these locomotives. In these specifications I have enumerated Falls Hollow staybolts in confidence that they are the best we can buy for the purpose intended. I bespeak for this company the best bolt you can make. We want the same bolt which you advertise as your standard goods. Yours truly,

J. B. BARNES, JR.
Supt. M. P. and M. Wabash R. R. Co.